QUIK TRIKS TO SMOOTH PRODUCTION

A busy day . . . Several rush jobs keep all hands going. Going like mad. Nerve racking? Maybe. But a great sight to see the whole shop running . . . and running smoothly.

Then . . . suddenly, a holder needs replacing. And *fast*, as there is no time to lose. A call to the stock room brings a repairman with a holder.

Question 1: How long will it take him to remove the old holder from the cable lead and to solder or clamp the new holder to the cable?

Question 2: Being pressed for time, how much chance is there of his doing the job *right*, while the weldor stands idly by and production is at a standstill?

Our illustration shows how the use of Jackson's "Quik-Trik" Cable Connectors will reduce such hazards.

Instead of fastening each holder directly to a cable lead, install the female unit of the cable connector to the lead (C), and attach the male unit (A) to a cable connected to the holder. A twist of the hand will connect the units.

In your stock room keep replacement holders on hand with a length of cable and a male unit of the cable connector already fastened to them, as shown on top of the page. Then, if a holder needs replacing, bring on a spare and connect it in a minute.

For work at greater distances from the welding machine, keep several lengths of extension cable on hand with cable connector units fastened to each end (B).

In shops where a man has to work alternately in different places, this flexible system will enable him to carry his holder *and cable* to another station and plug into an open cable lead there, without loss of time.

A twist of the hand will hold them tight. Large copper alloy contact area for efficient, "leak-proof" connection. Ample insulation for safe handling.

Jackson's QUIK-TRIK Cable Connectors

Model 1 fits cable size 4, 2, and 1, mechanical or solder.
Model 2/0 will take cables 1/0 and 2/0, mechanical or solder.
Model 4/0 takes cables 3/0 and 4/0, soldered connection only.

Posing (top of page) is the complete family of insulated Jackson electrode holders. Left to right. *Streamlined* holders JH-2 and 3, *Featherlight* models A-W and A-5S, *Quik-Trik* holders TA-3 and TA-1, *Copper Alloy* holders A-3S, A-3, and A-1.

The Quik-Trik holders are copper alloy holders with separate "Stinger Ends" and "Cable Connector" ends. This cable connector end is similar to the female unit of the Quik-Trik Cable Connector No. 2/0 and 4/0, but has longer insulator to form convenient handle.

Also shown (bottom of page) Jackson's Cable Lug, available in 180° and 45° angles. Also available (not shown), the Cable Splicer. All in three models: No. 1, 2/0, and 4/0.

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THE WELDING ENGINEER

THE WELDING ENGINEER, *with which is combined The Acetylene Journal*

A McGRAW-HILL PUBLICATION

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PAGE *Welding* ELECTRODES

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THE WELDING ENGINEER

DECEMBER, 1947

. . . and on Earth Good Will

THERE was a time when the approach of the Christmas season brought with it a feeling of universal friendliness. Prevailing thoughts were well expressed by the phrase, "Peace on Earth, Good Will towards Men." My, how times have changed!

Peace on Earth seems to be an unobtainable mirage. The meddling of power seekers and demagogues in various countries has so muddied the international waters that little sincere thought is being given to peace. And, in an Atomic Age, those in high office have learned so little from the lessons of the last war that they are now seemingly bent on heading a mad scramble towards destruction.

Despite the general stupidity, however, there are still some persons who believe in promoting Good Will towards Men. The hope of the world is in their hands.

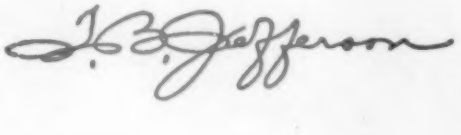
Good Will—never to be confused with charity—is simply a gesture of thoughtfulness extended to a fellow man. In view of present international and domestic squabbles, it is good to know that a feeling of friendliness can still exist between a man and his neighbors, an executive and his employees, a company and its customers.

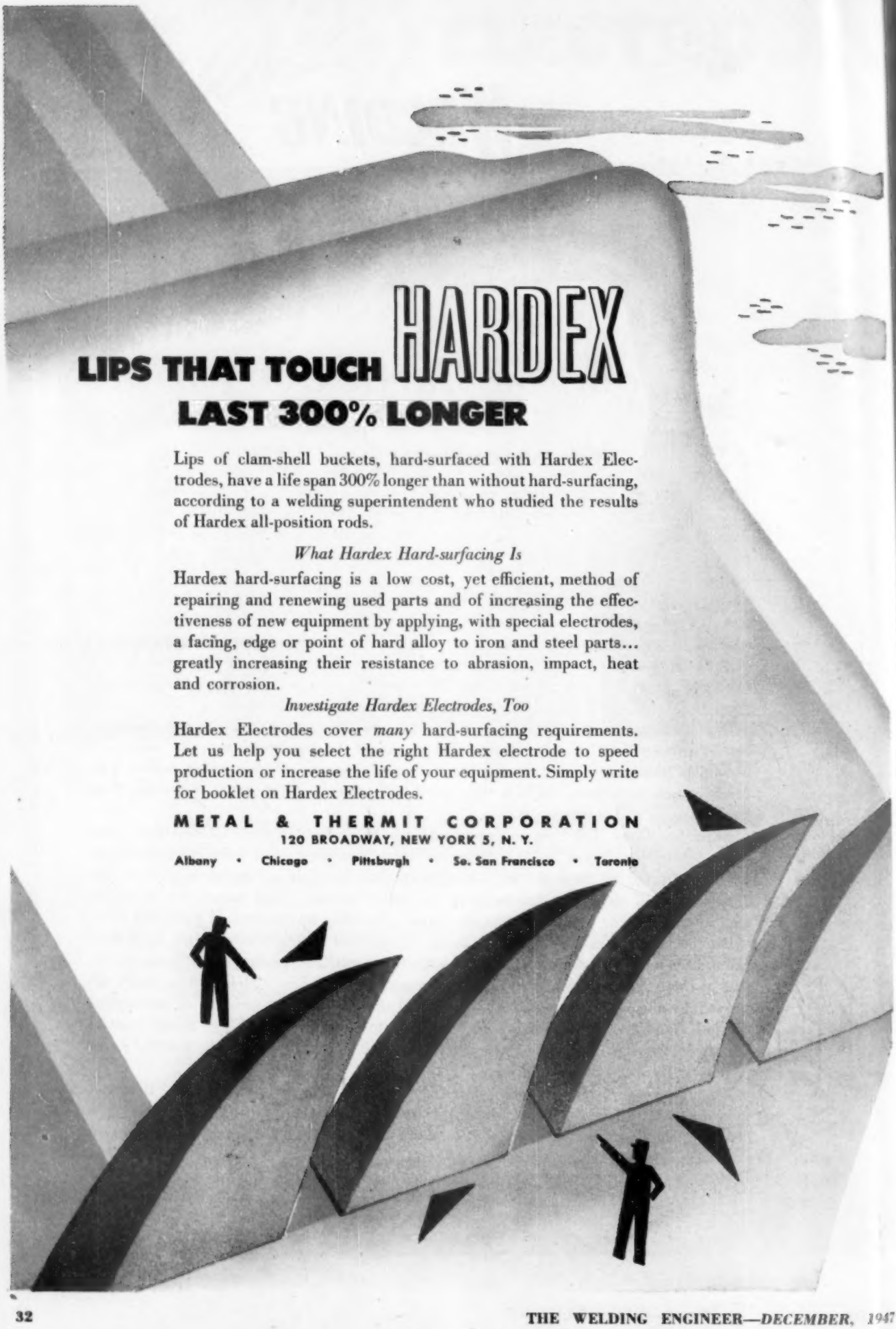
Good Will is the most valuable asset of an established company. It may be carried on the balance sheet at only a dollar, but it cannot be purchased for any price. It is wholly intangible—yet it is the foundation of business. High-pressure selling may bring in new customers, but it is their good will towards the company that turns them into repeaters and missionaries.

Never has Good Will been so important as in these days of material shortages, poor deliveries and production delays. Whereas customers were once held by friendly relations cemented by good service, excellent quality and fair prices, it is now all too often good will alone that has to carry the entire burden. This means that every organization, large or small, must concentrate on building up its store of good will.

It's the little things that count the most! Good Will is easily established by courteous acts, an understanding attitude, alertness, a spirit of general helpfulness on the part of the employees who serve as the company's ambassadors. It is just as easily destroyed by the opposite qualities. Good will simply will not flourish in an atmosphere of sloth, indifference, discourtesy or "too busy to be bothered." These things must be uprooted. Good Will is so important an asset that its virtues should be instilled in all employees from the owner on down.

We must never forget that the selling of Good Will is a never ending job. However, it is one that will pay ever increasing dividends. Let's continue to collect these dividends by showing our customers that we appreciate them and are doing our best to give them service beyond reproach.





LIPS THAT TOUCH HARDEX LAST 300% LONGER

Lips of clam-shell buckets, hard-surfaced with Hardex Electrodes, have a life span 300% longer than without hard-surfacing, according to a welding superintendent who studied the results of Hardex all-position rods.

What Hardex Hard-surfacing Is

Hardex hard-surfacing is a low cost, yet efficient, method of repairing and renewing used parts and of increasing the effectiveness of new equipment by applying, with special electrodes, a facing, edge or point of hard alloy to iron and steel parts... greatly increasing their resistance to abrasion, impact, heat and corrosion.

Investigate Hardex Electrodes, Too

Hardex Electrodes cover *many* hard-surfacing requirements. Let us help you select the right Hardex electrode to speed production or increase the life of your equipment. Simply write for booklet on Hardex Electrodes.

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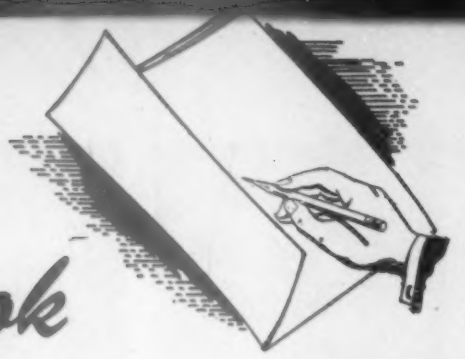


CONVENTION *Note Book*

BY CLYDE B. CLASON

A VERY large attendance, a friendly atmosphere, a generally high level of excellence in technical papers, upsetting of a sacred cow or two . . . such were the writer's impressions of the 28th annual meeting of the American Welding Society. Registration of near the 1,200 mark made this the best attended convention of several years. It was also one of the best.

The social side of life was not forgotten. The President's Reception packed a punch, and few of the 400 or so guests at the annual banquet will forget the witty remarks of Toastmaster Harris A. Goodwin or the seemingly inspired utterances of Nathaniel Leverone. It was a stroke of genius on the part of the program committee to select and secure Mr. Leverone, president of the Automatic Canteen Co. of America, as speaker of the evening.

TECHNICAL SYMPOSIUM

To go back to the Greeks for a word, "symposium," meaning originally a feast, is well suited to describe the technical part of the program. A repast of real, red-blooded meat was spread out with a lavish hand for those at the technical sessions.

Some of the more tasty morsels:

The paper by F. W. Myers, Jr., Watertown Arsenal, describing the revolutionary copper-bar welding process invented by German scientists.

The paper by W. D. Doty, Wylie J. Childs and W. F. Hess giving a severe case of indigestion to the sacred cow of pulsation welding.

The unprogramed surprise paper by Tom Crawford of Progressive Welder Co.

The high-speed motion picture studies of the welding arc produced by the Reid-Avery Co.

The rapid development of stud welding as a production process, as told by R. C. Singleton of Nelson Sales Corp.

Harold O. Hill, assistant chief engineer, fabricated steel construction, Bethlehem Steel Co., Bethlehem, Pa., was formally inducted as president at the closing business meeting on Friday afternoon, Oct. 24. An emblem was presented to the retiring president, L. W. Delhi, whom all agreed had given a year of able service to the association.

George N. Sieger, president and general manager of the S-M-S Corp., Detroit, was elected first vice-president, moving up from second vice-president. The latter office is now filled by O. B. J. Fraser, assistant manager, development and research division, International Nickel Co., Inc. Russell S. Donald, treasurer of the Electroloy Co., has been elected treasurer of AWS.

Other new AWS officers are:

John B. Tinnon, vice-president, Metal & Thermit Corp., director for a three-year term.

David Arnott, consultant, American Bureau of Shipping, director for a three-year term.

Thomas M. Jackson, chief electrical and welding engineer, Sun Shipbuilding and Dry Dock Co., director for a three-year term.

C. I. MacGuffie, manager of sales, electric welding division, General Electric Co., director for a three-year term.

Gilbert S. Schaller, professor of mechanical engineering, University of Washington, district vice-president (Pacific coast).

J. R. Wirt, process engineering department, Delco-Remy Division of General Motors, district vice-president (middle west).

Roy E. Lorentz, Jr., welding metallurgist, Combustion Engineering Co., Inc., district vice-president (southeast).

George M. Trefts, III, vice-president Farrar & Trefts, Inc., district vice-president (New England, New York and New Jersey).

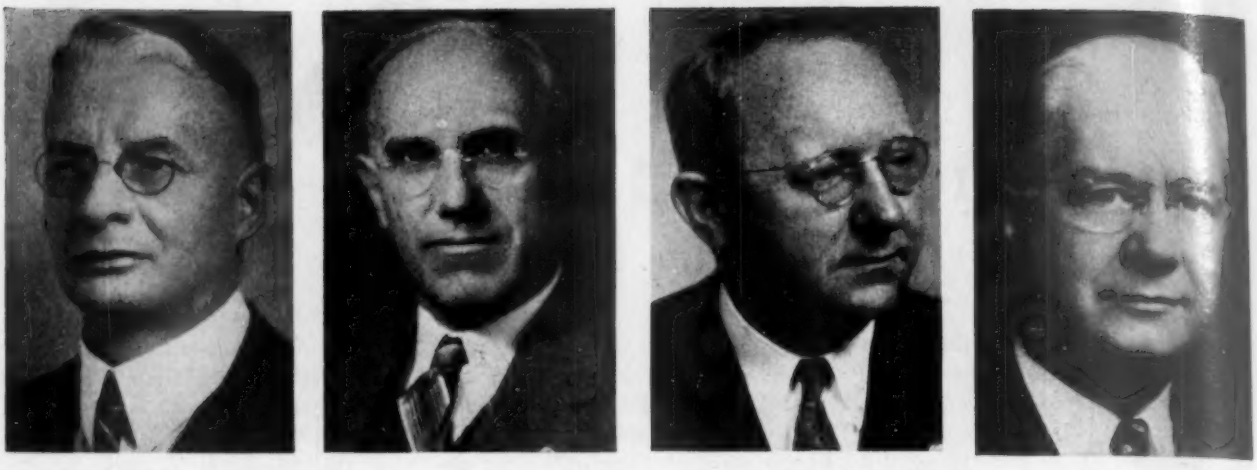
Monday evening, Oct. 20, was the occasion of a big double feature: the awards of prizes and medals and the annual Adams' lecture. The latter was given by G. S. Mikhalapov, manager, apparatus research department, Air Reduction Sales Co., who spoke on the structural strength of the welded joint. From 1942 to 1946, Mr. Mikhalapov served as supervisor of welding research for the War Metallurgy Committee of the National Research Council and had direct supervision of some 31 welding research projects conducted in industrial and educational laboratories throughout the country. He also served as a member of the subboard appointed by the Secretary of the Navy to investigate the designs and methods of construction of welded steel merchant vessels.

AWARDS AND PRIZES

Another Air Reduction man was honored in a different way at the same evening meeting. The 1947 honorary membership certificate was presented by President-Elect Hill to J. J. Crowe, assistant vice-president, Air Reduction Sales Co., Jersey City, N. J., for his contributions to the welding industry.

Dr. A. B. Kinzel, vice-president, Electro Metallurgical Co. and Union Carbide and Carbon Research Laboratories, Inc., received the 1947 Samuel Wylie Miller Memorial Medal, given each year for "conspicuous contributions to the advancement of the welding or cutting of metals." Dr. Kinzel is the author of many papers on the testing and welding of metals as well as on the metallurgy and physical chemistry of steels. An eminent lecturer, he has spoken before the Society of Culture of the USSR in Moscow in 1936, and given the 1944 Adams lecture of the American Welding Society. He was also this year's Campbell lecturer for the American Society for Metals.

Perry J. Rieppel and Manley W. Mallet, both of Battelle Institute, were given the Lincoln Gold Medal



AWS OFFICERS. Left to right: H. O. Hill, president, American Welding Society, 1947-48; George N. Sieger, first vice-president; O. B. J. Fraser, second vice-president, and Russell S. Donald, treasurer

award for their joint paper, "Arc Atmospheres and Underbead Cracking." As the major contributor to the paper, Mr. Rieppel, who is on the welding research staff of Battelle, was awarded the medal, but a certificate was given to both scientists. Mr. Mallett has been associated with Battelle since 1942 as a research engineer in industrial physics.

Julius Heuschkel, who is in active charge of welding research at the Westinghouse Research Laboratories, was the winner of the $750 first prize for the best paper emanating from an industrial source in the Resistance Welder Manufacturers Association prize contest. Mr. Heuschkel seems to be making a habit of this as he was also the winner of the 1946 RWMA award. His 1947 paper was entitled "Some Metallurgical Aspects of Carbon-Steel Spot Welding."

Second best paper from an industrial source was submitted by D. Bruce Johnston, who thus won a $500 prize. Mr. Johnston is an engineering graduate of the University of London, England, and is now a partner in the firm of McPhee and Johnston, New York, engineers, designers and builders of special machinery.

Horace J. Grover and Lloyd R. Jackson, physicists, Battelle Institute, earned $250 and certificates for the third best paper, "Fatigue Tests on Some Spot-Welded Joints in Aluminum-Alloy Sheet Material."

The $300 first prize for the best paper from a university source was won by Dr. Wendell F. Hess, Dr. T. B. Cameron, Dr. F. J. Winsor and Dutton J. Ashcraft, all present or former members of the staff of the Rensselaer Polytechnic Institute.

The $200 second prize for a paper from a university source went to Dr. Robert C. McMaster, research physicist, Battelle Institute, and Dr. F. C. Lindvall, professor of electrical and mechanical engineering, California Institute of Technology, Pasadena. Their paper was entitled, "The Interpretation of Radiographs of Spot Welds in Alclad 24 S-T and 75 S-T Aluminum Alloys."

The awards concluded with the presentation of the first and second prize certificates for the A. F. Davis Undergraduate Welding Award program to John W. Price, Jr., and Howard Sanders, who also received cash prizes of $200 and $150, respectively. These men were selected as the authors of the outstanding papers on welding published in undergraduate mazagines for the 1946-1947 college term. Mr. Price is now a senior at Rose Polytechnic Institute, Terre Haute, Ind., and Mr. Sanders a 1947 graduate in chemical engineering of Cornell University.

Session Highlights

It is impossible in the limited space at our disposal to attempt more than brief reviews of a few of the 59 excellent technical papers presented. Fortunately, that is all that is necessary since these papers are currently being published in the Society's official journal.

Let us now look chronologically, at some of the 19 technical sessions:

Monday morning opened on three simultaneous sessions: general papers, railroad welding, air-conditioning and refrigerators. At the general session, an excellent if somewhat mathematical treatise on the precision pressure regulation of various gases was delivered by J. K. Hamilton of Air Reduction Sales Co.

Three of the four papers presented at the railroad session were devoted to various maintenance problems. The fourth, by J. Van den Beemt of The Budd Co. discussed resistance welding of the stainless-steel railway car structure.

Some interesting information on mash welding was revealed by P. Bowman, Seeger Refrigerator Co., in a paper before the air conditioning and refrigerator session. This is a form of seam welding in which the lap is so small (about three times the gauge of the sheet) that an apparently seamless surface results. It is used at Seeger in forming the liners or food compartments of domestic refrigerator cabinets. Spot, arc and oxy-acetylene welding are also employed on the Seeger assembly line, which, says Mr. Bowman, uses the same production methods as an automobile body assembly line.

At the same session, Harold O. Jones, Air Reduction Sales Co., described a new method for the high-speed automatic oxy-acetylene welding of tubing and illustrated his remarks with a technicolor movie: "High Speed Continuous Tube Welding." Lengths up to 6,000 ft may be continuously welded along their longitudinal seams by a new mill that makes use of 125 flame-welding

AWARD WINNERS. Left to right: G. S. Mikhalapov, Air reduction, Adams lecturer; A. B. Kinzel, Union Carbide, Samuel Wylie Miller Memorial Medal; Perry J. Rieppel and Manley W. Mallet, Battelle Institute, Lincoln Gold Medal

heads to attain speeds as high as 200 fpm. At present the equipment is limited to ¼ and ⅜ in. tubing, but models are in prospect that will be able to handle up to 1-in. tubing and possibly attain speeds of as high as 500 fpm.

Copper-Bar Welding Method

Jumping now to Tuesday morning (Monday and Thursday afternoons were left open for visits to the Metal Show), we find that a four-star session of important papers was presented under the chairmanship of President-Elect Hill. The most startling of these was that by F. W. Myers, Jr., of Watertown Arsenal, "Semiautomatic Welding with Standard Manual Arc-Welding Equipment."

Mr. Myers' subject was the new copper-bar or Elin-Hafergut welding method invented by ingenious Germans. This welding process was discovered by Myers in 1945 when, as a captain in the U. S. Army, he was serving as chief of the Army Transportation Corps, Technical Intelligence, operating in the ETO. Its elements are a long electrode (or several electrodes jammed tightly together), insulating paper, a long copper bar with different grooves for different electrode diameters, a conventional type of electrode holder and a carbon-arc holder connected to a second source of current.

The method works best when a long fillet weld is to be made, although it is also serviceable for long butt welds. The plates are aligned and a strip of paper is laid down to insulate the electrode from them. The electrode is positioned along the intersecting edges of the plates, and another strip of paper is placed over it to insulate it from the grooved copper bar, the function of which is to shield and enclose the melting electrode. One end of the electrode is left extending slightly for connection to a conventional-type holder. The other end is then touched with the carbon arc to melt a portion of the electrode and allow it to reach the work. The electrode is consumed gradually, the insulating paper preventing it from short circuiting at any point except its melting end.

Electrodes 3 to 15 ft long have been used experimentally. Once started, the process is entirely automatic and requires no further attention on the part of the operator, who is left free to make a new set-up. The same polarity and very nearly the same current settings are used as in manual arc welds.

The experimental tests and data described in the Myers report indicate that the copper-bar welding method in general produces welded joints which may be termed quite satisfactory in cases where X-ray control is not paramount. With certain types of electrodes, however, it does not produce fillet welds free from porosity and having complete penetration at the root. A further limitation of the German process is that it does not lend itself to multiple-pass welding.

Another type of semiautomatic welding process that makes use of a modified "hidden arc" (submerged melt) head was mentioned by H. E. Cable, The Lincoln Electric Co., in his paper, "Composite Alloy Fabrication with the Hidden Arc." With this equipment (soon to be placed on the market), the current setting, rate of feed and arc length are automatic, but the operator has full control of the welding speed and direction. Mr. Cable told how hidden-arc equipment of both the automatic and semiautomatic types can be used to join steel of poor weldability without preheat or to deposit alloy overlays on mild steel. Mill rolls weighing 83,000 lb have been successfully rebuilt with metal deposited automatically.

Fusion Pressure Welding

The remaining two papers at this truly big-league session were of almost equal interest. The one by N. H. Cuke, Canadian Liquid Air Co., Ltd., described an oxy-acetylene pressure process which differs fundamentally from that ordinarily thought of as "pressure welding." Instead of the bonding taking place while the facing edges are in the "solid phase" or plastic condition, the weld faces are heated to melting temperature before the pressure is applied. This welding method is known as "open-butt," "open-joint" or "fusion" pressure welding, and it is said to result in very good welds. An advantage is that the weld faces require no edge preparation other than to be cleaned of scale and rust.

The tests so far have been confined to the joining of low-carbon steel sheets of similar (2 mm and 4 mm) and dissimilar (3 mm to 1 mm) thicknesses, but the feasibility of the

(Continued on page 64)

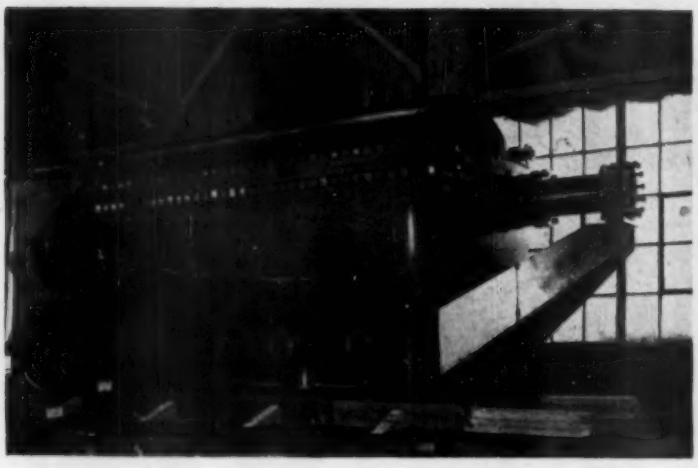


Fig. 1—Fabricated of solid stainless, this rotating leaf pressure filter measures 7 ft 4 in. in diameter by 12 ft 6 in. long. It is hydrostatically tested to 300 psi

Fig. 2—Solid stainless-steel test bars used to qualify weldors for stainless steel. Specimens are required to break outside the welds as these samples did

Advanced Techniques for Pressur Ve

Many new wrinkles in welding have been developed by the Goslin-Birmingham Mfg. Co. to speed and improve the production of specialized pressure vessels for many different industries

BY GERALD ELDRIDGE STEDMAN

THE South is becoming far more industrially aggressive. For instance, in my past five years' observations among 918 industrial plants throughout the nation, I have nowhere found more able use of the welding processes than in the plate shop of the Goslin-Birmingham Mfg. Co., Birmingham, Alabama.

Condensers and Filters

Goslin-Birmingham manufactures a wide line of condensers, crystallizers, evaporators, filters, process and special equipment for the oil, sugar, paper, brewery and chemical industries. Fabricated in all standard and in most special metals, these products are mostly in very heavy units to agree with the requirements of unfired pressure vessels under paragraphs U-69 and U-70 of the ASME code.

One of the Goslin-Birmingham products is the Vallez rotary press, a slowly rotating, leaf-type pressure filter (Fig. 1) for many processing uses, able to operate at -15 F or at temperatures above boiling point at atmospheric pressures. It filters volatile or explosive liquids safely and permits use of expensive solvents with negligible losses.

The 10 by 16 ft vacuum oil filter in the series, developed to filter lubricating oils at -20 to -30 F, is considered standard equipment among the engineering departments of major oil companies. It is the outstanding, continuous-process oil filter of the world and makes possible the efficient lubrication of airplanes at high altitudes and low temperatures. It could not be fabricated without employment of the most advanced techniques in arc and gas welding.

In the fabrication of varied types of filters and evaporators, G-B uses many types of firebox, mild, special steel plates of unusual analysis, stainless steel and stainless-clad sheets, copper, Everdur, aluminum, nickel and nickel-clad. All of these alloys and materials are required to fabricate vessels to the peculiar requirements of the oil, food, sugar and similar processing industries.

Weldors are qualified and regularly rechecked in relation to code requirements. Test bars of all work in progress are continuously submitted to physical tests, chemical analysis and microscopic examination in G-B laboratories to guarantee that weld deposits conform without deviation to code requirements and that they are the equivalent of the parent metal being joined.

★ PRODUCTION

Stainless Procedures

Much use is made of Type 316 stainless-steel plate, the usual weld being a single-vee butt joint. The metal-arc process is employed, using a Type 316 stainless-steel electrode. Base material is prepared by beveling each edge 30 deg, leaving a $\frac{1}{8}$-in. flat and a fit-up of $\frac{1}{8}$ in. between the flats. Tack welds are removed immediately before and just ahead of the first bead of the multiple-layer finish welding. Welds are made in the flat position wherever possible, with the electrode held in line with the groove at an angle of 30 deg from vertical. Reversed-polarity and short-gap electric current are used. The technical detail involved in the nine passes on a $\frac{5}{8}$-in. thickness of plate is tabulated in Table 1.

In training welding operators, G-B requires each weldor to pass tests on welding various types of stainless steel and varying types of stainless-clad steels. Specimens are welded and tested to qualify each weldor and to assure proper techniques involved

Fig. 4—Left to right: R. L. Williams, superintendent, plate department; W. W. McCain, general foreman; J. W. Adams, general works manager; H. DePriest, fabrication technician; Sam Stewart, weldor

Fig. 3—Main bay of plate department, looking toward the east. It occupies an inside floor space of 90 by 300 ft as well as a 100-ft outside bay and side storage yard

Vessels

in welding. High-pressure Vallez heavy-duty rotary filters, used to process concentrated acetic acid, etc., require the most meticulous welding. All tensile specimens must break outside the weld (Fig. 2) to pass this test. At frequent intervals, weldors are requalified to assure that they have not become careless or forgotten the perfections of their trade.

G-B shop technique goes one step further in providing trained shop observers who watch each welding operation in accordance with specifications of the controlling process drawing. They check all welding details and procedure to assure complete control without any deviation in any and every step.

G-B has a large grey-iron foundry with 70,000 sq ft of molding floor area. Its heavy machine shop is equipped with a full complement of machine tools, including such equipment as a 146-ft-wide by 26-ft-stroke planer and a 26-ft-diameter boring mill.

Plate Department

The G-B plate department occupies a 90 by 300 ft floor space under roof (Fig. 3) as well as an additional 100-ft outside bay and side storage yard. There are 172 employees in the department under R. L. Williams, superintendent of the plate shop. Some of the key personnel are shown in Fig. 4.

The welding shop has fully modern

Fig. 7—Welding jig for positioning the vat section for a 10 by 16 ft drum-type oil filter. This jig allows for shrinkage after welding

Fig. 8—Hold-down jig for welding gussets to the head of a 10-ft-diameter vacuum filter drum. A premeditated deformation of the work is employed

Fig. 5—Inert-gas arc welding finds many uses at Goslin-Birmingham. Here a helium-shielded arc is employed to fabricate a thin-gauge stainless pipe fitting

Fig. 6—Another widely adaptable process is the carbon arc. In this picture it is being used to butt weld deoxidized copper plates. See Fig. 12 for details

facilities for all types of welding: helium arc (Fig. 5), carbon arc (Fig. 6), oxy-acetylene, metal-arc and submerged-melt automatic. Its major equipment is divided among seven manufacturers; Goslin - Birmingham is married to no one and has an open interest for anything new in welding technique. It has both a-c and d-c welding equipment manifolded in batteries of welders.

J. W. Adams, general works manager, is one of the most capable shop management minds I have ever met. At 67 years of age, Adams is still bustling with energy, has profound technical understanding and an appreciation for human values that causes him to get unusually efficient operation throughout G-B plants. Ratio of supervision to workers in the plate shop is one to 15. This reflects unusually able supervision. Nowhere in the North can I remember a ratio of higher than one to 10.

Inspection within the shop is apart from production control. Though the shop has checkers, the engineering department has complete authority over all final inspection and is entirely independent in its operations, tests and judgments.

Drawings Control Production

Procedure is completely controlled on every job by preparing method process drawings before any work is started. These drawings reflect the best individual and group judgment and are prepared after conferences of all concerned—engineering, technical and shop parties. They carry full routing, specification, requirements and every scheduling detail.

Routing on every job tends to go approximately through this flow: (1) layout, (2) shearing, (3) torch cutting, (4) rolling, (5) breaking, (6) punching, (7) blacksmithing, (8) forming, (9) fitting, (10) welding, (11) cleaning and grinding, (12) testing, (13) check and approval. The unusual variety of work requires advance processing, planning, scheduling and routing.

Cutting and shaping is accomplished by oxy-acetylene and carbon-arc methods. Oxy-acetylene is standard practice, and many portable shape-cutting machines are employed. Powder cutting is used effectively on stainless steel. The clads are readily cut from the mild-steel side, either with or without sandwich fillers. After layout, a great variety of contours are cut in thicknesses of from 14 gauge to 6 in. or more, and flanges are formed from bar shapes in thicknesses of from $\frac{3}{4}$ to 5 in.

G-B tends to bring in supplier experts to establish new fabrication and processing techniques. Round table discussions establish new procedures. Basic control data is thus established between outside experts, engineering and shop. This is adopted as standard practice.

Jigs for Welding Assembly

The present plate shop was given over during the war to production of 155-mm shells and 90-lb demolition bombs, which production reached 110,000 shells and 30,000 bombs per month. Low costs attained topped Ordnance records. The considerable conversion problems have now been solved, and the plate shop (Fig. 6) is well equipped with many positioners and large jigs to tack and weld, all of G-B design and construction.

Among the variety of fitting-up jigs of G-B design on the floor, I noticed one to position the lower half of a vat section (Fig. 7) that was 12 ft wide by 18 ft long and became

Table 1. Nine-Pass Weld on $\frac{5}{8}$-in. Stainless Plate

Pass No.	Electrode Size, In.	Arc Gap, In.	Amp	Volts	Weave
1	1/8	1/16	120	23	None
2	1/8	1/16	110	23	None
3	5/32	1/8	175	25	None
4	5/32	1/8	175	25	Slight
5	5/32	1/8	175	25	None
6	5/32	1/8	175	25	None
7	5/32	1/8	175	25	Slight
8	5/32	1/8	175	25	Slight
9	1/8	1/16	120	23	None

Fig. 10—Much large-diameter stainless piping has to be fabricated to requirements of the oil and other processing industries. Here the metal-arc process is used

Fig. 11—Brazing copper tubing with the oxy-acetylene torch. Other methods of joining include silver soldering, low-temperature welding, carbon and helium arcs

a component of a 10-ft diameter by 16-ft drum-type oil filter. In such large fabrication, contraction after welding and cooling is anticipated by advance deformation. The only rule here seems to be that of practical experience.

I also noticed a unique layout operation on a 300-ton press brake in which a 21-ft plate, ½ in. thick, was being conically formed. The technique was to locate the center and follow around to form the halves comprising the frustum of the cone.

Fig. 8 shows a jack-down fixture for welding the eight gussets to the heads of the big 10-ft diameter vacuum filter drum. A premeditated ⅛-in. deformation was employed to allow the work to spring back to within a ⅛-in. tolerance after welding. Such heads are outside the main filter drum section and form a concentric trunnion body, which is later machined to close tolerances.

These drum shells require drilling. The sheets are laid flat and drilled in stacks of six plates (Fig. 9), guided by the top template. A portable vertical drill, using V-belt drive off a 3-hp motor, is mounted on a rubber-wheeled carriage. Moving of the machine rather than the work has helped to effect a phenomenal increase in the holes per hour drilled, and the template-guided match of the mating holes is perfect.

Problems in Piping

Much G-B work requires difficult fitting. In the fabricating of the large variety of evaporators, a great many of the connections require odd shapes and intersection fits with either circle, elliptical or tangential nozzles welded to cylindrical forms and intersections. The problem is to accomplish a weld design that will provide a neat fit with a minimum of deposited weld metal. One example I noticed was the fitting of a nozzle flange and body to a large evaporator cylinder. With the flange located by setting it upright and in its true position, the intersection hole in the cylinder was established and cut. The cutout became the pattern for the end of the nozzle body. The nozzle body cylinder was then made and fitted, and the intersection was welded to provide a close fit without use of excess weld metal.

A large amount of piping is involved in evaporator fabrication, some of it very large stainless (Fig. 10). The intricate fitting of standard sections, bonds and nozzles between main intersections of varied diameters with other diameters at varied angles requires the use of templates to provide the accurately mated parts to go together in field assembly.

Manufacture of vacuum apparatus in the chemical industries requires much copper tubing from ½ to 10 in. ID. This needs peculiar bending, forming and fabrication into a variety of sizes, shapes, intersections. Techniques of forming and welding must be unusually precise. G-B uses all methods of joining: silver soldering, low-temperature welding, oxy-acetylene brazing (Fig. 11) and brazing with the carbon and helium arcs.

Fig. 9—This mobile drill uses a template to drill six drain holes at a time through ½-in. plate

Fig. 13—This "trolley crane" works on the pantograph idea. Jib cranes support each end of the central beam, which moves on rollers

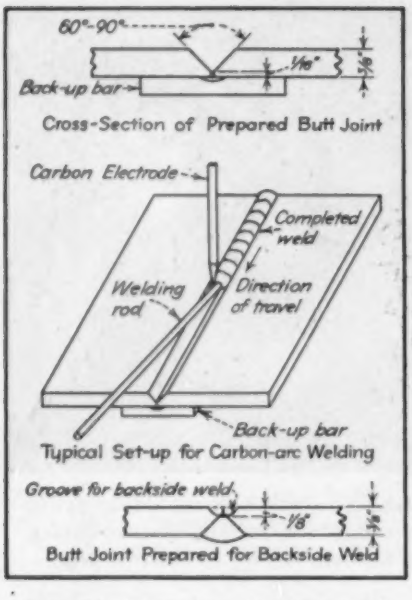


Fig. 12—Procedure for butt welding ⅜-in. plates of deoxidized copper by the carbon-arc process

Much intricate and varied small steel piping and tubing is also required, particularly in drain pipes for vacuum-type filter drum systems. Probably as many as 400 different jigs are in inventory for this small work, and all of the parts or assemblies produced are duplicates to assure interchangeability.

Carbon-Arc Copper Welding

Within this maze of procedures, I observed enough advanced welding techniques to fill a volume. It is with difficulty that I select one example for detailing. This is the procedure for welding ⅜-in. deoxidized copper (0.1% P maximum) established by Howard DePriest of the G-B welding department. This is a carbon-arc welding job, using a filler rod of silicon-bronze (96% Cu, 3% Si and 1% Mn). A flux of 90% fused borax and 10% sodium fluoride is mixed with water-free alcohol for application to the work. Plate edges are prepared for a 60 to 90 deg single-vee butt joint. A cross-section of the prepared butt joint and a typical set-up for carbon-arc welding are sketched in Fig. 12. Here is the detailed procedure:

"Bevel the edges of the ⅜-in. deoxidized plates 30 to 45 deg on each plate, leaving 1/16-in. flat. Use a copper back-up bar with a groove 1/16-in. to ⅛ in. deep and ⅜ to ½ in. wide. Fit the bottoms of the beveled edges together as nearly as possible. Clean a minimum of ½ in. on each side of the joint on both sides of the plate with a power-driven wire brush or grinding wheel; take care not to leave particles of steel or abrasive sticking in the copper.

"Apply flux with a clean brush to both bevels of the joint and to the adjacent cleaned surfaces. Remove all oil, grease and dirt from the welding area with carbon tetrachloride immediately before welding.

Topside Procedure

"Use a ¼-in. silicon-bronze welding rod on the topside weld with a welding current of 450 amp and a ¼-in. carbon or graphite electrode. Hold the electrode perpendicular to the work and strike the arc on either the welding rod or on a copper block provided for that purpose. On seams with free ends, start the weld near the middle and progress to each end. This will serve to limit the locked-up stresses within the weld. Keep the carbon or graphite electrode well pointed and hold the welding rod in the groove at a low angle to the work and in line with the groove. Make the topside weld in one pass, feeding 2 to 3 in. of rod for each 1 in. of weld at a speed of 10 to 12 linear inches per minute."

Procedure in accomplishing the backside weld is as follows:

"Chip out the backside ⅛ in. deep with a round-nosed tool. Use 1/16-in. silicon-bronze welding rods and a current of 400 amp with ¼-in carbon or graphite electrodes. The position of the welding rod, electrode, etc., is the same as given for the topside weld; start the weld near the middle of the seam and carry to each end. Make the weld in one pass, feeding 1 to ½ in. of welding rod for each inch of weld at a speed of approximately 12 linear inches per minute."

The technique for repairing defects in the welded copper plates is to chip out the defect, leaving a canoe-shaped slot. The arc is then struck on the small copper block provided for this purpose, and part of the sound weld is remelted about ½ in. from the end of the repair zone. A welding rod is applied to fill the chipped-out portion; then the rod is removed while approximately ½ in. of the sound weld is remelted. The arc is broken on a small copper block which is placed adjacent to the weld to prevent a crater from being left in the weld metal. In the case of wide repair zones, the welding rod is applied first to one side and then to the other without attempt to join them. When the slot has thus been narrowed, a last pass is made down the middle to bridge the gap.

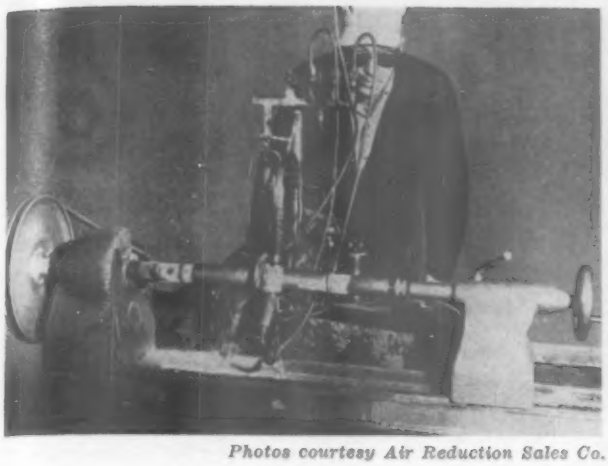
The G-B plate department has a side storage yard serviced by locomotive crane. Inside, overhead cranes of 10-ton and 15-ton capacities are maintained.

A unique crane has been developed by Superintendent Williams to facilitate certain types of material movements to the heavy forging machine and steam hammers in the plate shop. This "trolley crane" (Fig. 13) consists of two regular jib cranes with an added beam on rollers. Each end of the beam is supported by one of the jib cranes. The load, carried along the crane-supported beam, can be placed at any point or angle within the working radius of the swing of the two jib cranes. This crane trolley works on the pantograph principle and permits unusual dexterity in material handling.

The Chief Executive

Joseph T. Hartson, the new Goslin-Birmingham president, who joined the company in October, 1946, has had an unusual experience in engineering, production and executive direction of many aviation successes. He sold Lindbergh his engine for that record-making ocean flight and gave Admiral Byrd critical assistance in 1929. After many important executive positions, Hartson finally became president of The Glenn L. Martin Nebraska Company as the war came on, and he operated the Omaha plant, a wholly owned Martin subsidiary employing 16,000 people. Among the bombers produced was the group rigged up to carry atomic bombs over Hiroshima and Nagasaki.

Hartson's hobby is duck shooting but before giving himself entirely over to that sport, he wanted to have a fling at applying modern management techniques to a business that was not dominated by one customer. He found his chance at Goslin-Birmingham and is already assembling a brilliant staff, many of whom were with him at Omaha. In the next few years, G-B will make much national industrial news.



Photos courtesy Air Reduction Sales Co.

Fig. 2—With a mandrel at each end, the pins were spun in a small lathe for flame-hardening. This picture shows the action of the flames and the quenching ring

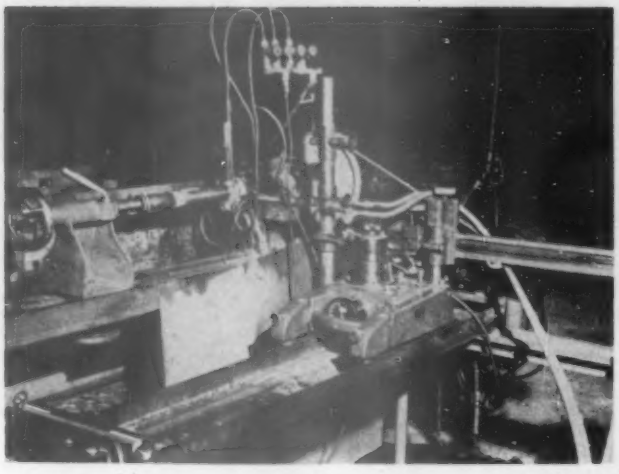


Fig. 3—The carriage of a motor-driven straight-line cutting machine carried the flame-hardening head longitudinally as the pin rotated at a speed of 450 rpm

The Pins Had Slotted Ends

What would have been a routine job of surface hardening steel pins was greatly complicated by slots, which tended to close up whenever heat was applied to them

BECAUSE of the severe wearing future ahead of them, a quantity of master pins for heavy-duty tractors had to be hardened over their entire outer surfaces. It looked like an easy job to the Flame Processing Corp., Minneapolis, when it accepted the contract. But—the pins had slotted ends!

The pins (Fig. 1) could not be hardened unless they were subjected to some form of intense heat. But the heat necessary for hardening partially closed the slots, destroying their fine tolerances. Specifications called for the finished inside surface to be held to within 0.001 in., and this simply could not be done with any hardening method known.

A manufacturer's technical sales division was consulted. After careful study of the problem a plan was suggested that the contractor thought was worth trying out. Here it is:

First, since any method of heating would shrink the slots, accept this fact and allow for it in advance. This was done by pressing mandrels into the ends of the master pins to expand their openings 0.002 in. oversize to compensate for the inevitable shrinkage.

Next, the progressive spinning method of flame-hardening was chosen since this method of controlled localized heating permits the maintenance of close tolerances. The pins were spun at 450 rpm in a small lathe (Fig. 2) and heated and quenched by means of a standard flame-hardening head. The carriage of a portable cutting machine (Fig. 3) carried the torch and quench longitudinally at a speed of from 7 to 10 ipm as the master pin rotated.

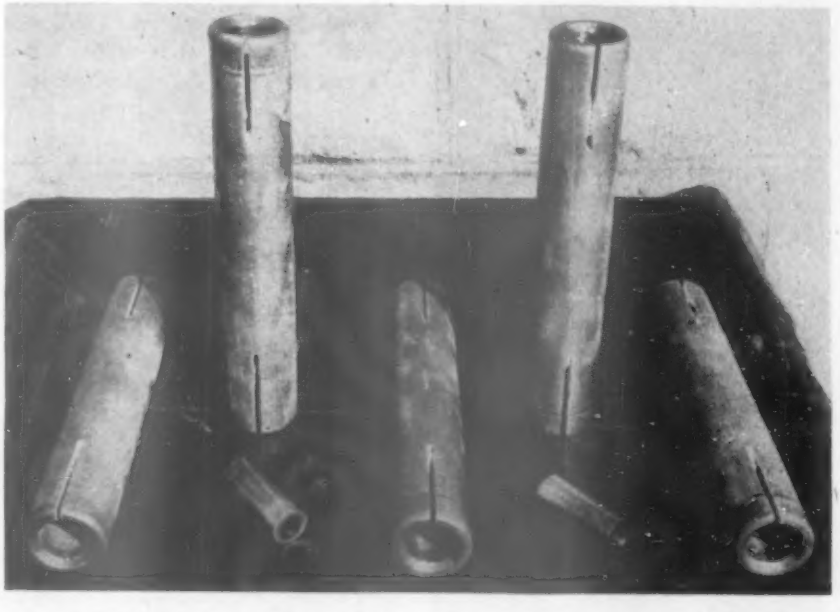


Fig. 1—These steel pins for heavy-duty tractors had to be surface hardened. The problem was to hold the slotted ends to the required tolerances

After completion of the hardening, the mandrel pins were removed, allowing the slots to return to their original dimensions. Operating on a production basis, the Minneapolis contractor found it possible to turn out 45 master pins per hour—all hardened along their entire lengths to a depth of $\frac{1}{8}$ in. and a hardness of 60-62 Rockwell C.

Fig. 1—Bench welder for fine-wire work. It is equipped with phase-shift heat control and an electronic timer

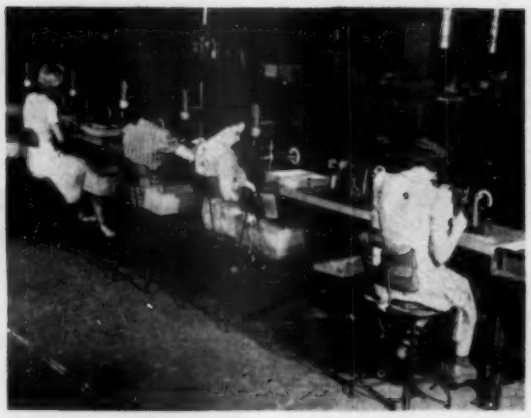


Fig. 2—Production set-up for welding fine wires. These welders are foot-operated and have synchronous precision controls that give either half-cycle or one-to-ten cycle timing

Fig. 3—This self-contained butt welder includes an annealing station, wire cutters and a magnifying glass

★ OPERATION

Fine Wires Can Be W

Fig. 6—Solderless connections may be made by spot welding stranded wire to copper terminals. Note support left for the wire

Fig. 7—Some other welded connections (size given by match). The tubular eyelet or its equivalent is needed as a mechanical support

THE first point to be settled in considering the subject of this article is: How small is a fine wire? To one person, a fine wire might be 0.125 in. in diameter; to another, 0.0005 in. Some limitations, however arbitrary, are necessary, so this article will be confined to wires ranging from 0.0005 to 0.060 in.

Generally speaking, the cross-wire welding of two wires of most of the ferrous materials or alloys is a very simple procedure and should be classed as a projection weld. There are many everyday articles manufactured by this method: wire baskets, trays, bathroom fittings, kitchen equipment, fencing of many types, toys, etc.

The electrical industry finds extensive use of resistance welding for fine wires. Throughout the entire industry, including radio, many billions of welds are made each year in the manufacture of various types of incandescent lamps, electronic tubes of all kinds and electrical control equipment.

Among metals resistance welded as fine wires, about a dozen assume a prominent place: copper, iron, silver, gold, platinum, tantalum, tungsten, molybdenum, irridium, nickel, palladium . . . also binary and ternary alloys of all these, with or without the addition of chromium.

In principle, the welding of fine wires does not differ from any other type of resistance-welding application. However, the welding equipment must be scaled down to fit the wire. Obviously, a welder designed to weld a 1-in. diameter wire or rod could not be expected to function in welding wires from 0.0005 to 0.010 in. in diameter.

As in all types of welded structures, design plays an important part. Structures should be so designed that the joints are readily accessible in order to facilitate low-cost, high-quality welding. Needless to say, the design must also fulfill the desired engineering requirements.

Dissimilar Wires Welded

A small-diameter wire may be welded to a large-diameter wire as readily as two wires of the same diameter are welded. For example, a 0.001-in. wire might be welded to an 0.020-in. wire. Almost any combination of dissimilar metal wires may be welded; usually the only difficulty experienced is in cases where brittle alloys are formed in the joint or where there is too great a difference in the melting points of the two materials.

Fig. 1 shows a motor-operated, bench-type spot welder which can be

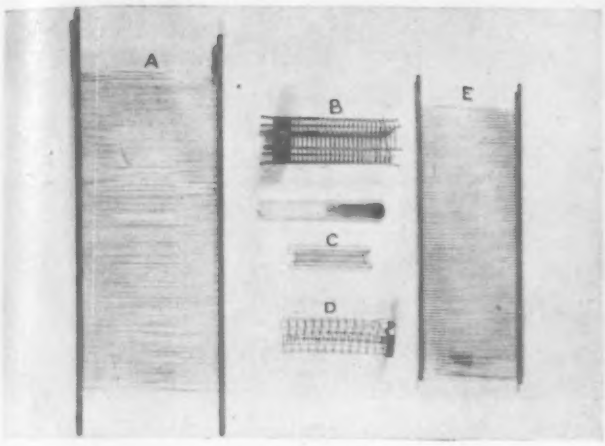


Fig. 4—Electronic tube components fabricated by spot and seam welding. See text for explanation of letters. Match gives the size of these tube assemblies

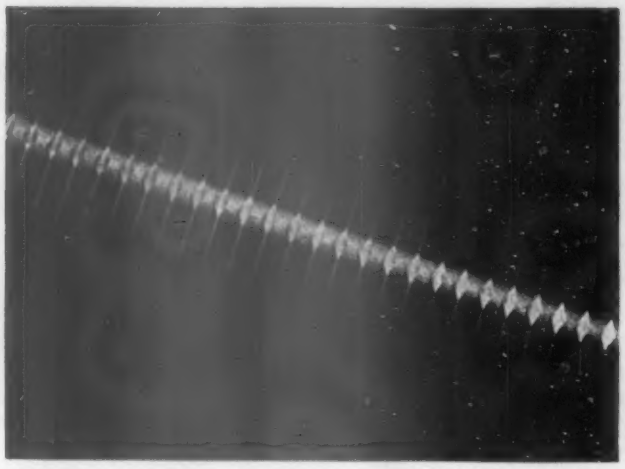


Fig. 5— Magnified edge view of assembly "A" in Fig. 4. Note the uniform size and appearance of these welds

Be Welded

Wires of cobweb delicacy are being production welded for filaments of incandescent lamps and electronic tubes. Other applications are legion

BY R. T. GILLETTE
Works Laboratory,
General Electric Co.

used for welding two wires of the same size ranging from the smallest up to those about 0.035 in., or for welding wires up to about 0.015 in. to wires of approximately 0.060 in. It is equipped with a three-speed drive, standard clutch and a precisely synchronous electronic control that provides welding times of from one to ten cycles as well as phase-shift heat control. The electrode-force range is about four ounces to approximately 50 lb and is obtained by using three sizes of pressure springs. Current range is about 25 to 2,500 amp.

This type of machine is quite flexible, and it can be equipped with a variety of electrodes, jigs and fixtures which will adapt it to a wide variety of work, particularly for filaments, grids and other parts for electronic tubes and small-wire work.

Fig. 2 shows a production-line setup of a different type of small-wire welder. These foot-operated welders are equipped with synchronous precision controls that give either half-cycle timing or one-to-ten cycle timing. When used with other than the half-cycle control, these welders have one inherent weakness: If a relatively long welding time is used, it is possible for an exceptionally fast operator to beat out the timer and thus produce welds of erratic quality. The same type of welders may be equipped for air operation if this method is preferred.

No matter which type of welder is chosen for a given job, the design and use of adequate, high-precision tooling is most essential if trouble-free, accurately welded assemblies are to be produced.

Fig. 3 shows equipment that will butt weld wires of from 0.003 to 0.010 or 0.015 in. This completely self-contained welder is equipped with automatic welding control, annealing station, wire cutters, magnifying glass and all necessary instruments. The upset pressure and welding current are adjustable for the various sizes of wire within its range. In larger sizes, the same type of butt welder is available to weld wire up to 1 in. in diameter.

Wires for Electronic Tubes

Fig. 4 shows various electronic tube elements fabricated by resistance welding. "A" consists of 0.007-in. molybdenum cross wiring welded to 0.060-in. molybdenum side wires. "E" shows 0.007-in. molybdenum cross wire welded to 0.040-in. molyb-

(Continued on page 47)

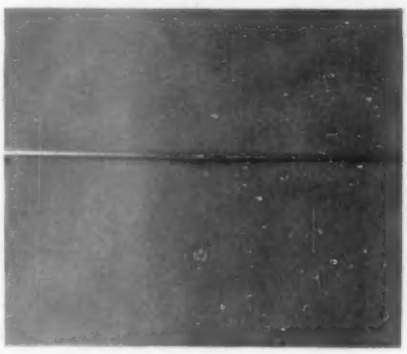
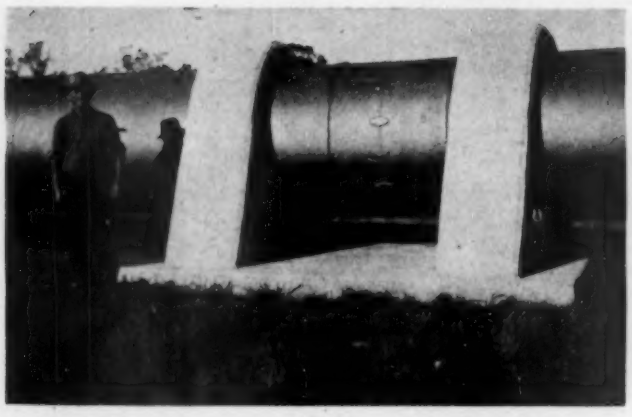
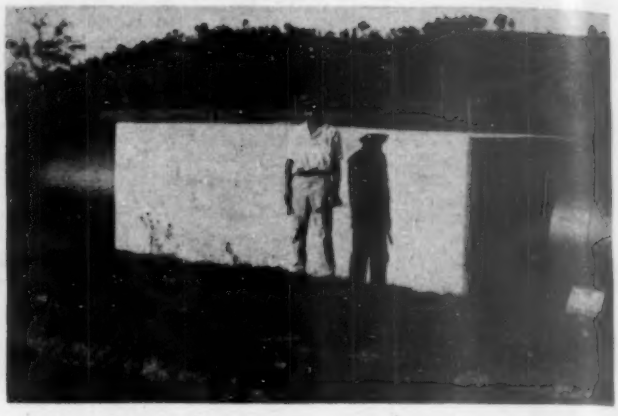


Fig. 8—These wires are 0.004-in. stainless steel. Butt weld (above) was made on the butt welder shown in Fig. 3; Cross-wire welds (below) on the spot welder shown in Fig. 1



Thrust block for an 8-deg horizontal angle. These concrete blocks were placed at each change of direction



These mammoth concrete anchor blocks resist the stresses at the ends of long sections of welded pipes

★ CONSTRUCTION

Welded Pipe Line "Down U

THIS article describes the basis of design, methods of construction and results obtained on a 54-in. mild-steel pipe line laid above ground and welded into a continuous line 9⅜ miles long. The pipe is part of a duplication of a 36-in. conduit conveying water from the Chichester reservoir to Newcastle, New South Wales, Australia.

General Description

The location of the new pipe line is from Chichester dam to the end of the wood-stave pipe section of the existing line, which it parallels and to which it can act as an alternative. The wood-stave pipe requires a good deal of maintenance and has to be shut down for short periods in winter for replacement of staves affected by dry rot.

From the Chichester dam to the Williams river, a distance of 5 miles, the new pipe is laid generally about 15 ft away from the existing pipe. The Chichester river is crossed three times, the pipe being laid in trenches in the rocky bed of the river and concreted in solid in preference to spanning overhead, thus reducing flood hazard and maintenance on bridges.

From the Williams river to the end of the work, about 4⅜ miles, the country is open and undulating. In this section the new line is laid at a distance of approximately ¼ mile from the existing 36-in. pipe line from Chichester to Newcastle.

The mild-steel pipes and specials were manufactured and delivered along the pipe-line route by Hume Steel Limited. Laying and welding were done by Messrs. Court and Braithwaite. Earthworks, concrete construction, pipe painting and incidental work were carried out by The Hunter District Water Board.

As actually constructed, the line consists of 54-in. ID by ⅜-in. mild-steel welded pipes, with cement lining 1¼-in. thick (effective diameter 51½-in.). It is laid above ground, except for short lengths such as river, road and some stock crossings.

The pipes are welded into a continuous line after laying and anchored by concrete blocks to resist the forces developed by temperature changes and water pressure.

The adoption of the continuous welded method of construction was the result of a study of the design and construction of steel pipe lines in other sections, particularly Western Australia where the method was introduced on the greater part of the 350-mile, 30-in. Goldfields pipe line.

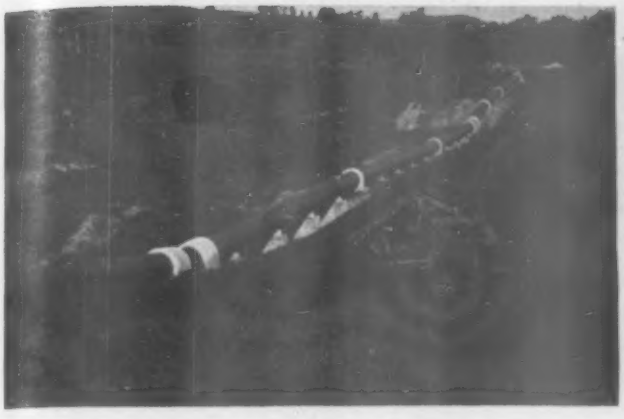
Design Considerations

The design of anchorages and angle thrust blocks is determined by the range of temperature and by the hydrostatic pressure to which the pipe line will be subjected. A temperature range of from 25 to 125 F was adopted under pipe-empty conditions. The pipe-full condition was assumed as a range from 45 to 105 F.

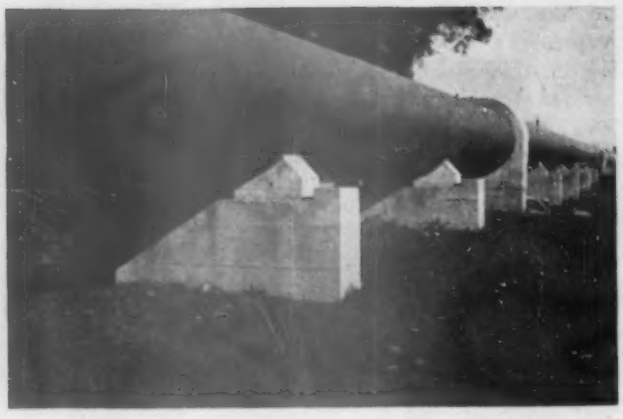
In order to reduce the ultimate load on anchorages, the pipe line is made continuous at mean temperature, thereby enabling designs to be based on a temperature range of ±50 F under pipe-empty conditions or ±30 F under pipe-full conditions. The design of anchorages and thrust blocks must provide for resisting the expansion and contraction stresses over this range, in addition to the usual stresses due to the pressure of the water in the pipes and beam stresses under pipe-full conditions.

The unbalanced hydrostatic pressure allowed for on any section is that due to the head of water when Chichester reservoir is full. The maximum value is at the end of the work where the head is approximately 300 ft.

In the empty main, the maximum



The new 54-in. steel pipe line and the old 36-in. wood-stave line crossing undulating country in parallel



A typical length of straight pipe line, showing the anchorage provided to support and align the pipes

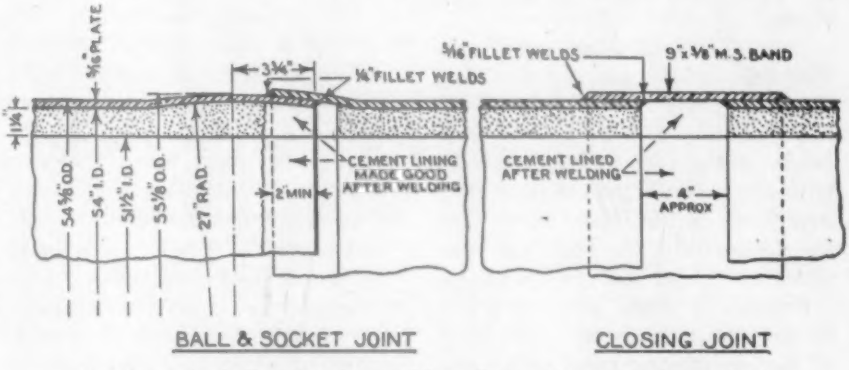
n Under"

The land of the kangaroo and the kookaburra is also noted for progressive feats of engineering, among them construction of this 54 in. welded pipe line

BY J. M. C. CORLETTE AND W. S. SMALLMAN*

stress due to temperature effects of a range of ±50 F and bending over supports at 20 ft centers is longitudinal and amounts to 9,200 psi.

With a full main, the maximum stress due to temperature range of ±30 F, bending stress at supports and hydrostatic pressure for a head of 300 ft is circumferential and amounts to 12,200 psi. From actual readings, the temperatures adopted for design have been confirmed.



Details of the ball-and-socket and lap closing joints are shown above

Pipes and Pipe Supports

Pipes were manufactured at Hexham, 10 miles from Newcastle, where Hume Steel Ltd. erected a factory for the purpose. They were supplied to an effective length of 20 ft, having an approximate weight of 3½ tons per length.

Pipe ends were made to a spherical shape, making a "ball-and-socket" joint which allowed a "pull" of up to 3 deg and made a tight fit when forced home, very suitable for fillet welding.

Supports are normally at 20-ft centers but are spaced 30 ft at some creek crossings. For 30-ft spans, plate $\frac{1}{4}$-in. thick is used in the pipes, and the edges of the ends are left unbeveled; these joints are made by inside and outside fillet welding a 9-in. by ⅜-in. band to the pipes. Pipes are self-supporting over spans.

All concrete work on any section of the work was completed before final welding at mean temperature was carried out.

Laying and Welding

The pipes were laid by means of a crane fitted to the rear of an old 60-hp Caterpillar tractor. In places where the tractor could not operate, the pipes were laid by means of shear legs.

The "ball" or spigot end of a pipe was entered in the socket end of the next pipe. The two pipes were then forced together by means of a wire rope and a puller winch inside the pipe, until the ball end had penetrated at least 2 in. inside the socket end.

On top of the piers, the pipes were laid on concrete cradles. These cradles were cast in steel forms and were shaped to the outside of the pipe. To insure good contact between the pipe and cradle, a pad consisting of a double layer of five-ply bituminous roofing felt was placed on the shaped surface. The area of the pipe to rest on the pad was wire brushed and coated with red lead before the cradle was placed in position.

When in position, straight lengths of pipe were welded together into sections approximately 200-ft long. Each such section had to be held at some point in a concrete block. Between each 200-ft section a gap of 4 in. was left to allow the pipes to expand and contract until final welding could be completed. One such opening was also left between angle blocks.

The closure of the gaps left at the free ends between lengths of pipe previously welded together was effected

*Colonel Corlette was formerly chief engineer, Hunter District Water Board, New South Wales, Australia. He is now practicing as a consulting engineer in Newcastle. Mr. Smallman is an engineer in the Hunter District Water Board, sponsor of the pipe line.

by fillet welding split collars over the gaps. The collars were 9 in. wide by 3/8 in. thick. Each collar was first welded (inside and outside) to the end of one pipe, thus forming a socket which would not restrain longitudinal expansion and contraction until welded to the other pipe. Final link-ups were made at a later selected time. The collars were supplied rolled to shape with a single transverse cut. They were slipped over the pipe ends during the laying and cramped into position for welding. The length of steel was adjusted to the circumference of the pipe by either cutting or welding.

Welding at mean temperature, generally referred to as "final welding," was not carried out until all concrete work on anchors and angle thrust blocks had been completed.

All lap joints were fillet welded both inside and outside. This insured ample strength and also sealed out water from inside the lap of the plates.

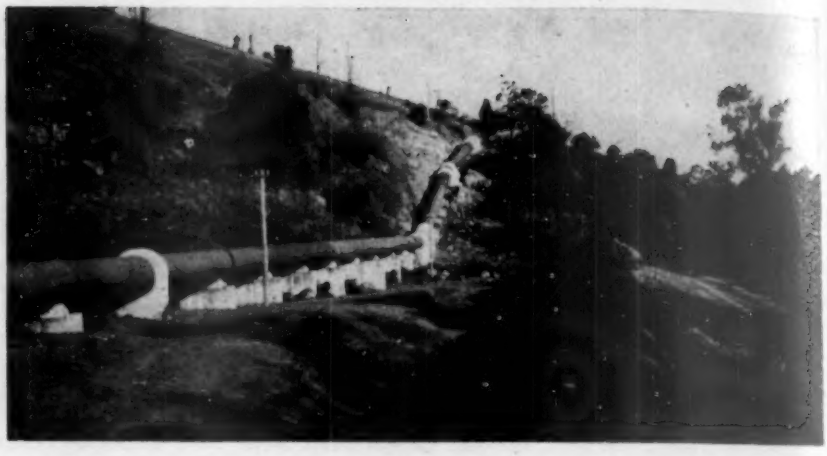
Standard 1/4-in. fillet welds were used for 1/4-in. plates and were laid down in single beads in the downhand position and in two or three beads in the vertical and overhead positions. Standard 5/16-in. fillets were used on the 3/8-in. bands used for closures, and the work was completed with beads laid in all positions.

Portable 200-amp welders driven by gasoline engines were employed by the contractors; these were capable of handling up to 1/8-in. electrodes.

Welding Continuous Lengths

It was intended that the long welded sections should be welded soon into continuity between the anchors. Long delays occurred, however. Longitudinal movement of the free ends due to temperature changes from winter to summer caused a good many of the felt pads to be forced out of position and damaged many of the cradles, especially those nearer to the free ends.

The damaged cradles were replaced or repaired and adjusted after final welding. In a number of instances, a pad of soft cement mortar was spread on the face of a cradle instead of the felt when replacing it in position. This provided a satisfactory close contact with the pipe barrel and was considered to be better than a felt pad.



Both horizontal and vertical angle thrust blocks were needed on this grade

The final closure into continuous lengths between anchors was to be effected at mean temperature. This meant that the welding had to be done at all open ends simultaneously as temperatures are rarely stationary for long. They are generally rising or falling, sometimes rapidly. Since there were many points at which welding had to be done, more weldors and operators were required than were likely to be available. In one section alone there were 31 closing welds to be made on a length of 1 mile, 194 ft between anchors.

Consequently, it was necessary to compromise and allow some range of temperature within which the closures could be completed. The specification required the contractor to make closing welds when the temperature of the pipe was between 65-75 F, thus fixing the mean temperature at 70 F. This temperature of 5 F below the designed mean was adopted so that the welding might be subjected to a slightly higher compressive than tensile stress. The behaviour of other pipe lines shows that welding failures usually occur during the winter because of tensile stresses. The temperature of the pipe was taken to be the average of the temperatures indicated by thermometers fixed at four points around the barrel at a position near where welding was being carried out.

The procedure, as adopted, was to allocate the closing welds evenly to the available weldors. Work was then commenced as soon as the temperature had risen to the lower limit or fallen to the higher. In summer weather, the final welding was usually done at night as more stable temperature conditions prevailed then.

A single bead 4 ft long was laid as quickly as possible externally on each side of the pipe at each closing weld. This took about 25 minutes. The operator then moved on and dealt similarly with all the welds allotted to him. If possible, he arranged to reach all his welds without moving the welder, but in many cases such a move could not be avoided. Careful arrangements beforehand reduced loss of time in moving to a minimum. When all first beads had been laid, the pipe became continuous between anchors and the welding had to be completed while the temperature was still in the favorable 65-75 F range.

Reinforcing First Welds

The initial welds were estimated to be sufficiently strong to withstand any stresses due to temperature changes likely to occur for some hours, but strengthening was required before they could be left for later completion. Accordingly, the last preliminary weld made was extended by laying a single bead all around the outside and by completing a 1-ft length of 5/16-in. fillet weld on each side of the pipe. The weldor then treated each of his other welds similarly. The reinforcing of the preliminary weld took about 30 minutes for each band. Completion of the external welds could then be left to next day as the strength would be sufficient to resist stresses due to the temperature changes likely to occur. The internal welding of the loose ends of bands was carried out following the completion of each external weld; it was not, however, a matter of urgency as the external weld alone

Terminal anchor near Chichester dam, Chichester river in foreground

would carry the full load. Access to perform the internal welds was gained by entry through manholes cut in the pipes; the cutout sections were later restored.

Cement lining was made good at all joints after the welding had been finished. The completion of the cement work took some time after the final welding. The external surface of the pipes was not given any protective coating until after laying since the exposure of the uncoated pipes gave time for the mill scale to loosen. After scraping and wire brushing to remove loose scale and the light film of rust that had formed, the pipes were given a base coat of red lead, followed by a finishing coat of grey paint.

Service Test

In order to try out the pipe line under severe conditions, one section was completed between anchors and allowed to remain empty for eleven months. It was thus exposed in the empty condition during a full summer and winter. Under these severe conditions careful examination failed to reveal any sign of pipe movement relative to the concrete supports or of any blocks. No movement or other undesirable development was observed after the pipes were filled and put under pressure. A summer and a winter have passed since the pipe line was put in service and no defects have yet appeared.

It was found advisable to carry the pipes awaiting final closure welding on temporary supports as the movement of the free ends with temperature changes was believed likely to damage cradles if considerable delay occurred in the final welding.

The thanks of the authors are due to the Hunter District Water Board, Newcastle, New South Wales, for permission to publish this paper and to those members of the board's staff who assisted in the design and construction of the work.

FINE WIRES CAN BE WELDED

(Continued from page 43)

denum side wire. The small part shown at "C" is fabricated by welding 0.003-in. tungsten cross wires to 0.025-in. nickel side wires. These three parts, "A", "E", and "C", are all welded on a series seam welder specially designed and constructed for this task. Where production warrants the cost of equipment, it is often advisable to design and build a welder for a specific job since this will result in a better product at a much lower cost.

The 0.007-in. tungsten cross wires shown in "B" were welded to 0.025-in. molybdenum side wires on a spot welder. At "D" we find 0.007-in. tantalum wires welded to 0.012-in. tantalum side wires—also on a spot welder. The standard book match shown in the center gives a size comparison of the parts.

These welded parts are typical of hundreds welded from many sizes of many different metals. Parts much smaller as well as parts many times as large are made from the same materials by the same methods.

In Fig. 5 we see a magnified edge view of the part at "A" in Fig. 4. This shows the welds in detail, giving us an idea of their consistency of size, appearance and quality. Properly controlled conditions of time, current and electrode force must be combined with good tooling in order to obtain welds of this uniform quality.

Solderless Connections

Fig. 6 shows another type of wire spot welding which is rapidly replacing soldering for making electrical connections. Tinned stranded wire is welded to terminals of tinned copper, and the terminals are welded to phosphor-bronze springs. It will be noted that in no case does the spot weld cover the entire area of the clip, spring or terminal. If it did, the wire would be "nicked" at the edge of the terminal. By allowing the electrode to cover only part of the surface of the terminal, a modified tubular mechanical support is left for the wire. The welded section thus produced gives good mechanical and electrical attachment, and this method also gives a maximum of flexibility to the stranded wire or flat-stranded conductor. Since no solder is used, none can run up the wire.

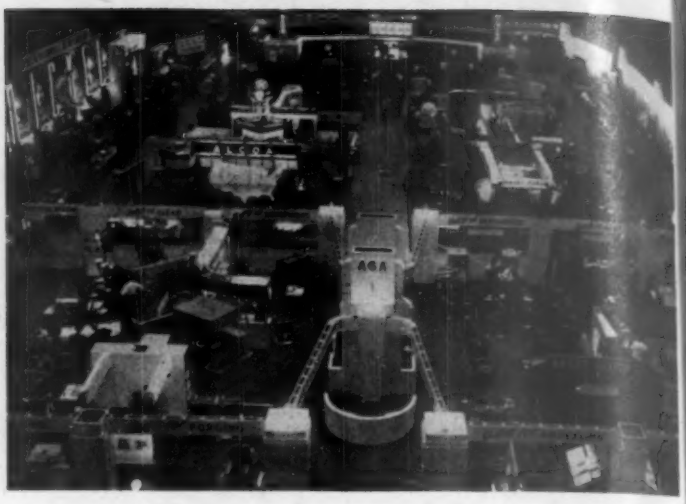
Fig. 7 shows other control and electrical parts fabricated by spot welding instead of by soldering. Among other advantages of this method may be cited the complete elimination of flux, which might possibly promote corrosion in the parts. The use of the tubular eyelet as a mechanical support (or one of the other supports shown here) is quite essential to the success of the weld.

Fig. 8 shows cross-wire welds made on the spot welder shown in Fig. 1, and butt welds made on the butt welder shown in Fig. 3. Both of these welds are between two pieces of 0.004-in. stainless-steel wire, and the photos were magnified 25 times.

In conclusion, it may be said that satisfactory resistance welds can be made in fine wires ranging in size from 0.0005 to 0.060 in. or larger if the proper control, sound design, adequate jigs and fixtures, trained supervision and competent operators are used. This type of welding is, of necessity, precision work, and the equipment must be carefully maintained and serviced.

No attempts have been made to give definite welding schedules as there are several variables that are difficult to predict except on the actual work part.

29th National Metal Congress



Exhibitions at the Chicago Metal Show furnished additional proof of the importance of welding to metal-fabricating industries

BY JOHN H. GIROUX

BETWEEN 30,000 and 40,000 visitors came from all parts of this country, Norway, England, Canada and Mexico to attend the 29th National Metal Congress and Exhibition, held October 18 to 24 in Chicago's International Amphitheatre. For the first time in the history of this event, the show ran for seven days. A total of 401 exhibitors displayed an array of products which covered every phase of the metal-working industry.

Approximately 28% of the floor space was occupied by manufacturers of welding equipment or firms in some way closely allied to the welding industry. Among the exhibitors occupying the two floors of the Amphitheatre were 59 producers of iron and steel, copper, magnesium and other non-ferrous metals—manufacturers of tool steels, stainless and high temperature alloys and alloy steels.

Testing Your I. Q.

For those who wished to test their knowledge of welding, the U. S. Naval Engineering Experiment Station, Annapolis, Md., had a question board set up with four classifications of questions: Pressure Vessels and Pipe Welding; Brazing and Overlaying; Job Shop Procedures; and Ship Building. Next to each question were two buttons—under the headings "Yes or No." A chime indicated the correct answer; a buzzing sound the incorrect. Here are a few of the questions—would your answer buzz or chime?

1. It is necessary to use E-7020 electrodes to weld a pressure vessel made of flange quality mild steel.

2. In overlaying mild steel in brass or bronze there is no danger of cracking the steel.

3. No preheating is needed to weld to silicon bronze employing carbon arc welding to deposit silicon bronze welding rods.

4. Welding with a copper-alloy filler metal is a suitable method for repairing a cast iron boiler.

5. Arc welding a broken spring with stainless steel electrodes destroys their temper adjacent the joint.

6. It is satisfactory to stress relieve a pressure vessel built of 18-8 Cr-Ni steel at 1200 F.

7. The application of the block or cascade method is a satisfactory substitution for preheating when welding heavy sections of medium steel in cold weather.

Answers may be found at the end of this article.

One prominent manufacturer of welding equipment displayed a new semi-automatic, 600-amp submerged-melt welder. The granulated flux container and nozzle are held in the hand, thus permitting the size of the bead to be determined by the operator. The rod is then fed automatically to the welding nozzle from a reel attached to the machine. Cylindrical objects may be set on a turntable, speed of which governs the size of the bead.

Continuous demonstrations of a new flame-hardening machine brought many visitors, who marveled at this equipment which is capable of flame-hardening 250 automotive starter gears an hour. The part is rotated on a spindle and heated by two or four flame heads until the predetermined temperature is reached. The flame is then stopped, the spindle backs up and disposes the part into an oil quenching bath. Hardnesses of 58-60 Rockwell C are obtained on SAE-1050 steel. Some of the parts that may be hardened are: clutch gears, valve tappet, etc.

Welding positioning equipment was not to be left out of this conglomeration of new products. Both manual and motor driven units were shown, ranging in capacities from 100 to 6,000 lb. One particular participant displayed a machine which allowed the workpiece to be rotated at any desired speed by remote control. It was obvious that this means of welding circular vessels on turning rolls has many advantages over previous methods.

A "three-in-one" a-c welder which operates on 110-220 volts and is capable of welding, brazing and soldering was another interesting stopping point. The welder contains a pilot arc of high frequency. Hard-facing, metal-arc and carbon-arc welding are all possible.

Very few visitors missed the novel demonstrations of inert-gas welding of aluminum without the use of a filler rod.

About 66 firms were represented in the heat-treating equipment field, including the manufacturer of an induction heating unit for internal diameters. There were also 49 cleaning, finishing and plating equipment manufacturers who displayed processes and materials for metal cleaning and finishing and 45 companies engaged in the manufacture of testing and inspection equipment.

Answers to questions: 1. No, 2. No, 3. Yes, 4. No, 5. Yes, 6. No, 7. Yes.

Fig. 1—Steam pressure reduction station in basement. Note the welding fittings and tapered pipe sections

Fig. 2—Close-up of tapered section in Fig. 1. The taper was formed by splitting and bending the pipe wall

Problems in *Pipe Fitting*

Installation of the numerous pipe lines needed in the Cleveland Clinic addition called for many varied applications of welding

ALL of the joints connecting the endless lengths of pipes running throughout the seven-story addition to the original three-story Cleveland Clinic building are welded. Brackets and hanger frames used to simplify the installation of the piping are of welded design. The work was directed by Smith & Olby Co., Cleveland heating contractor.

An example of the extensive use of welded connections may be viewed in Fig. 1, which shows the welding fittings and tapered pipe sections in the steam reduction station located in the basement. The taper (Fig. 2) is made by flame-cutting one section of pipe longitudinally and then notching out a "V" so that the wall may be bent to produce a taper.

Hanger Frames Welded

Welding also helps to fabricate the rectangular hanger frames (Fig. 3) which hold the copper water lines at each floor level. The ends of these frames are scarfed 45 deg and then joined at the corners with inside and outside welds. The "plumber's sleeves" for the various sizes of pipes are cut from tubing and then welded to the rectangular frame with continuous fillet welds. The three sleeves of equal size in Fig. 3 are for 3-in. water lines carrying chilled water to the air-conditioning units. The larger sleeve is for a 4-in. steam line while the smallest sleeve is for a return line.

Brackets for Risers

In Fig. 4 a weldor is shown completing the joints of the steam risers. These risers extend from the basement to the top of the building and are held at each floor level by brackets. The brackets are made from 2 by 2 angles, their corners being formed by notching one flange and then bending. Also visible in this illustration are the holding rings; these are cut from pipe and fillet welded to the frame, which in turn is welded to the building structure. The pipe is held by wedges until insulation can be applied.

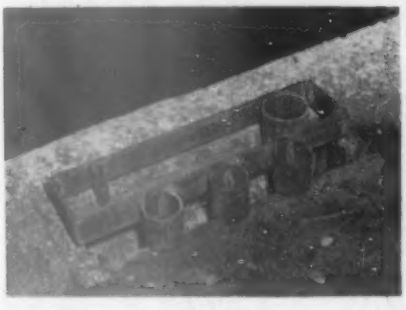


Fig. 3—Welded frame and sleeves. Fitting over openings in the concrete, this device holds the copper water lines at each floor

Photos courtesy The Lincoln Electric Co.

Fig. 4—Working on steam risers. These welded pipes extend from the basement to the top story

Fig. 1—A bad case of tooth decay in its crowd gear laid up this English-made power shovel. New teeth had to be made

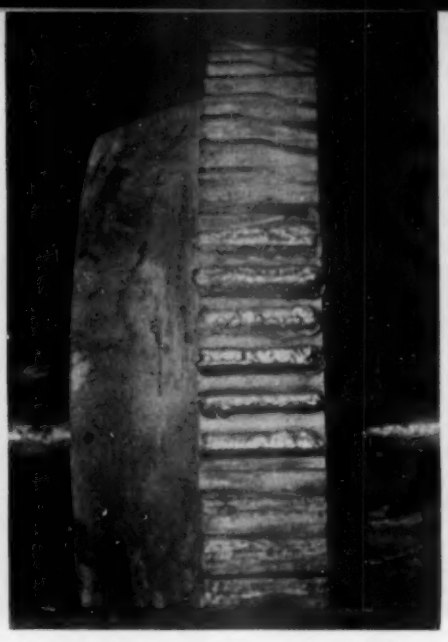


Fig. 2—The crowd gear after the damaged teeth had been ground smooth for welding. Note triplets of holes drilled and tapped to receive studs

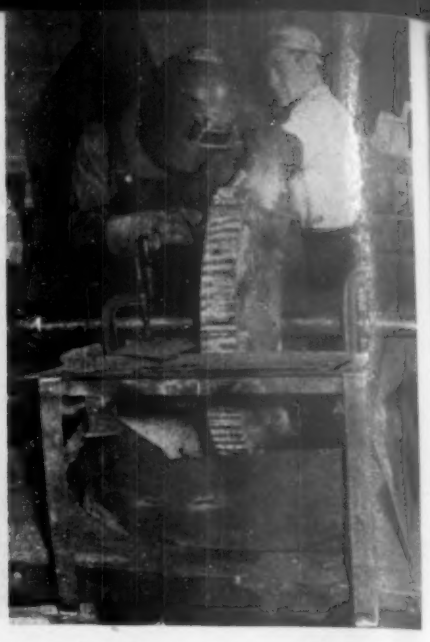


Fig. 3—The gear was rotated on an axle while the teeth were built up. Preheating was carried on continuously in the furnace shown at the bottom

★ MAINTENANCE

Crowd Gear Gets a N

Dentistry with welding electrodes saved a badl eeded

GETTING a new set of teeth is a major operation for either man or machine. This time the dentist was a weldor, the patient the massive crowd gear on an English make of a power shovel (Fig. 1), owned and operated by a Canadian excavating contractor.

The crowd gear is the main cog in the shovel, upon which all operations are dependent. It provides the driving power to swing the boom and also acts as a brake. Trouble is often encountered in the latter function since the teeth are called upon to withstand considerable shock. The trouble usually starts with one tooth, which breaks off, wholly or in part, and leaves a gap that causes the gear to slip the next time that it is engaged at the same point. When the gear slips, the adjacent tooth has to withstand a correspondingly heavier shock, so it breaks, too. Finally, the condition progresses to the point where all the teeth are affected.

TWO LEFT FROM 76

The crowd gear on the shovel concerned had been stripped until it was almost toothless. Only two of the original 76 teeth remained intact, and it is significant that these two good teeth were directly opposite each other. In addition to the badly mutilated teeth, cracks had developed in the hub and spokes of the gear. Obviously, something had to be done, or the shovel could no longer operate. A new crowd gear was obtainable only from England, and it would take three or four months to secure delivery. The Canadian owner, the Laurentide Equipment Co., Ltd., was unwilling to lose the services of the shovel for so long a period. Its management brought the problem to the Bowers Machine Co., Ltd., a Toronto job welding and machine shop.

Could the teeth be restored by welding? Yes, if the gear were steel, opined the Bowers expert. However, the gear wasn't steel; it was cast iron, always a tricky material to weld or braze. The Bowers man was dubious about the outcome, but he agreed to call in another doctor on the case.

The second consultant was G. D. Peters & Co., Ltd., Toronto distributor of welding supplies. Specialists from Peters' service department examined the crowd gear and reported they believed that a successful welded repair was possible provided that the job was carried out under carefully controlled conditions and with an electrode capable of producing a machinable weld in cast iron. They recommended a flux-coated nickel-cored electrode that is now being widely used for salvaging iron castings. This non-ferrous electrode deposits weld metal of machining characteristics similar to those of cast iron. Furthermore, the fusion zone surrounding the weld is narrow and soft enough to allow accurate machining.

CLEANING AND GRINDING

When Bowers received the gear for repair, it was completely coated in the thick grease necessary to lubricate such heavy-duty equipment. This grease was dissolved in carbon tetrachloride heated to a temperature of approximately 200 F. The gear was dipped a portion at a time into the solvent and brushed vigorously while immersed in order to remove all traces of grease and grime.

The next step was to grind the rough surfaces on the teeth to leave them smooth for welding. The cracks in the hub and spokes were also veed out by grinding. Where teeth were

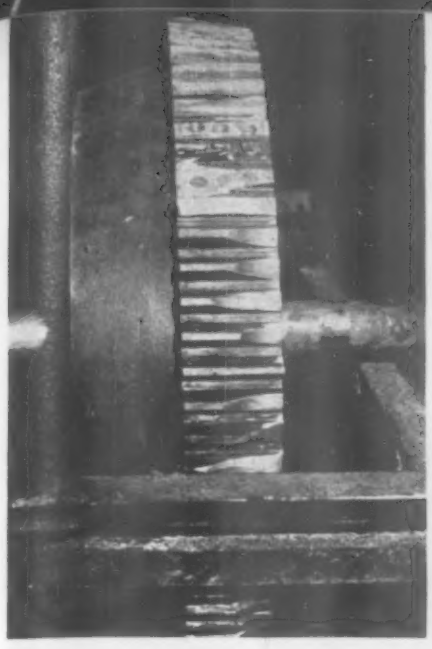


Fig. 4—Six of the new teeth in the half welded condition. Before undergoing repairs, the crowd gear had only two good teeth left out of 76

Fig. 5—The finished gear as set up for milling. The weld metal machined as easily as the original cast iron. The repair took two weeks altogether

a New Set of Teeth

eeded power shovel from a three-months' layoff.

broken off flush, studs had to be inserted to provide anchors for the new metal. Fig. 2 shows two places where a trio of holes were drilled and tapped to receive the threaded studs.

Heating Continuous

When the gear had been ground and fitted with studs, it was swung on a piece of round bar stock so that the teeth would be in horizontal position and rotatable for downhand welding (Fig. 3). The gear's bottom portion was enclosed by sheet metal to form a temporary oven in which an oil torch preheated the casting to approximately 600 F.

Because of the constant danger of locked-up stresses and cracking, preheat temperature had to be maintained throughout the welding operations. This meant that welding had to be continuous from the start to the finish of the job. To distribute the welding heat evenly and avoid distortion, the work was staggered by doing one pass per tooth at a time. The gear was rotated a quarter turn between each pass.

Special brass formers were inserted in the depressions between the teeth to guide the weldor in depositing metal to the correct height and contour. The use of formers saved considerable machining time by preventing excessive build-ups. The nickel-based electrode metal did not adhere to the brass formers, which could readily be removed after they had served their purpose. Some of the gear teeth in a half welded condition are shown in Fig. 4.

Electrodes of ⅛-in. diameter and a current setting of 95 amp were used throughout on the teeth. Welding with this nickel-cored electrode for cast iron is much the same as welding with a coated mild-steel electrode. Some of the rules given by its manufacturer are:

In general, the welding current should be as low as possible for smooth operation, good bead contour and a good "wash." Heavy deposits are recommended as the fewer the number of passes, the less stress in the finished weld. A short arc—about 1/16 inch—is suggested, and the weld metal may be laid down in either straight beads or by weaving. Weaving should not exceed three times the diameter of the electrode core wire. Either direct or alternating current may be used.

After the teeth had been built up by welding, the hub and spoke cracks were filled with aluminum bronze. This material was selected because of its strength, considerable shock being transmitted through the spokes to the hub. A ⅛-in. electrode was used, d-c, reversed polarity, conforming to AWS-ASTM Specification E Cu Al-A. This particular electrode deposits weld metal having tensile strength of 77,000 psi and an as-deposited hardness of 119 to 121 Brinell.

Slow Cooling Necessary

Upon completion of all welding, the gear was buried in a very low coke fire and allowed to remain there overnight for a very gradual post-weld cooling. It was ready for machining on the following morning.

Machining required a total of 42 hours and had to be carefully done. No particular difficulty was encountered with the welded teeth, however, as their added metal machined with the same ease as the cast iron. The finished gear and the set-up for milling the teeth is shown in Fig. 5.

Because of the magnitude of this job, the welded and machined repair cost more than a new gear. It nevertheless constituted a major saving for the Laurentide Equipment Co. in that the shovel was back on the job within two weeks instead of in from three to four months.

Fig. 3—"Tagalong" trailer in service at the rear of an ordinary dump truck. Note the tongue, cable and pulleys which adapt the truck for towing. A tractor was formerly required to tow such heavy equipment as this power shovel

Heavy-Duty Trailer Production

PIONEER in the use of arc welding on heavy-duty trailers, the Rogers Bros. Corp. has developed efficient production methods through extensive jigging and positioning. A wide assortment of custom-built trailers are fabricated for the moving of heavy machinery and construction equipment.

Welding "wherever metal meets metal" produces exceptional strength in proportion to weight, eliminates perforation of metal and does away with excess weight of rivets or overlapped metal. No cracks are left between metal parts to retain moisture and invite deterioration.

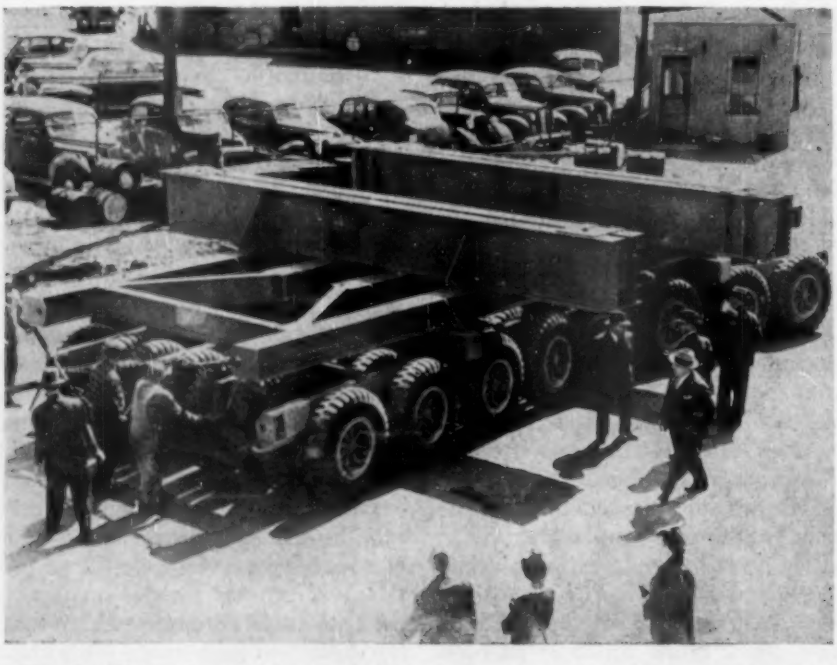


Fig. 1—Claimed to be the world's largest trailer, this 600-ton capacity job has 64 wheels. It was built to transport equipment across the desert

Outstanding example of a Rogers-produced trailer was the widely publicized 600-ton capacity model (Fig. 1) built during World War II for carrying equipment of a highly secret military project across desert sands. Sometimes called a "30-day miracle," this trailer had 64 wheels on double rocking axles.

From Storage to Shaping

Let us first consider some of the physical aspects of the Rogers plant at Albion, Pa. Most of the welding is done in three large bays, each including roughly about 4,000 sq ft of working area. The first and largest bay is used for storage of large plates, beams, angles and bars, tires (mounted and unmounted) and various pieces of equipment for beginning fabrication procedures.

Overhead cranes move these heavy pieces of steel to layout tables, where

Fig. 5—Tagalong frames are tacked together on a special jig (background) with self-locating stops. In front of this jig is a freshly painted trailer, and in the foreground another trailer is receiving its hardwood floor

Large-size trailers to move heavy construction equipment are a specialty of Rogers Bros. Corp., Albion, Pa. The frames are fabricated by carefully planned welding

BY WALTER RUDOLPH

blueprints and templates are used to mark them for flame-cutting, shearing or bending. Metal-cutting saws, a plate shear that rips up to $\frac{5}{8}$-in steel, 12 ft wide, and an eight-foot shape-cutting machine controlled by a magnetic tracing device are utilized for this work in addition to a large number of manual torches.

Rogers receives its oxygen in large storage tanks that are left on trailers sitting outside the plant. The gas is piped inside the plant, the piping running down structural columns to torch hose connections spotted at strategic points in all bays. A cylinder of a hydrocarbon fuel gas is located near each oxygen outlet (Fig. 2).

The shaped pieces flow on roller conveyors from the first bay to the second, where additional processing goes on and subassembly takes place on many trailer parts. A crane assists the conveyor rollers to move the various components to the steel horses on which subassembly is done.

Although the Rogers plant has a separate machine shop, some equipment has been moved to this bay for speeding certain operations such as axle assemblies and brake shoe fabrication (to be discussed later). Odd pieces of machinery especially suited for the second bay stage of operations are scattered throughout the area. These include a 200-ton hydraulic press that forms plates for brake shoes; a smaller air-powered press for assisting with spacer bands and a press for forming the trailer stake pockets.

Fig. 4—Another view of a Tagalong trailer. The drawbar rests on the ground while the shovel is being loaded on the trailer from the front end

Fig. 9—Two small rollers position this cylinder while the end plate is being welded on. A simple idea that can be adapted to a wide variety of purposes

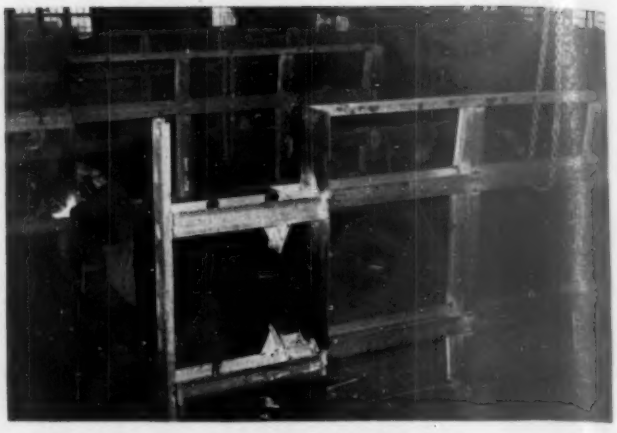


Fig. 6—Upon leaving the tacking jig, the Tagalong frame is held on its side by a chain from the grab hook of an overhead crane. The bottom is clamped

Many special jigs are brought into play here, too. Noteworthy among these is the large one for forming the "gooseneck" on a trailer front. This jig holds in position two heavy flanged side plates, two main girders, structural cross-members and steel plates for the top and rear.

Assembly in Third Bay

The work in the second bay is flexibly scheduled so that the semi-finished parts can be roller conveyed into the third bay at just the point in the assembly line where they are needed. The goosenecks, for example, are pushed into about the mid-point of the last bay, where they meet frames that require them.

When the welded assembly is complete, the trailer, resting on steel horses near the end of the final assembly line in the last bay, is wired for lights and has brake assemblies added. An overhead crane then moves it slightly further down the line for spray painting, usually an orange color. A floor of hardwood planking is bolted to the trailer in the last stage of assembly.

The above is but a quick appraisal of operations on the whole in relation to each other. The welding equipment includes 32 arc welders, a-c and d-c, of capacities from 175 to 300 amp. Flat-position welding is emphasized throughout, and electrodes of comparatively large sizes are utilized: 5/32, $\frac{3}{16}$ and ¼.

The heaviest welding is, of course, done on the varied frames constructed at Rogers. A typical frame comprises two main beams of heavy cross-section mounted on rugged, widely spaced axle brackets at the rear and welded to the strong gooseneck at the front. Paralleling the longitudinal course of the two "backbones" are outriggers at either side; these side members are also attached to the gooseneck at the front and to the wheel housing at the rear. Cross members are welded to the two "backbones" and also to the outriggers.

This design is reported to produce an outstandingly strong and efficient structure. Also, open side design of the rear wheel housing permits installation of the greatest possible tire capacity in any given width of trailer.

Fig. 2—Oxygen is piped from outside tanks to torch outlets and is mixed with a hydrocarbon fuel gas from individual cylinders for flame-cutting

Mass-Production "Tagalongs"

Production of a recently developed trailer called the "Tagalong Front-loader" most nearly approximates anything at the Rogers plant being done on a mass-scale assembly basis since the other trailers are practically always custom-built jobs. Fabricated in 10, 15 and 20-ton models, Tagalongs at present constitute a majority of the 40 trailers being produced monthly at Rogers.

Principal feature of the Tagalong is that it allows an ordinary dump truck to be used for towing construction equipment from job to job (Fig. 3). Heretofore the heavy trailers used to transport such equipment required a tractor to tow them. On the trailer in Fig. 3, the gooseneck has been replaced by a 5-ft drawbar that

Fig. 7—After all downhand welding possible has been done with the trailer frame in a side position, it is then laid right-side up for further flat welding

Fig. 10—Brake shoe assembly. The weldor at the right welds webs and shoes together; the other workers rivet on linings and true the shoes on a sanding wheel

may be rested on the ground (Fig. 4) to permit the trailer to be loaded from the front. The towing tongue, cable and pulleys which adapt the dump truck for pulling this trailer do not limit the normal usefulness of the vehicle.

To speed production of Tagalongs and keep the cost comparatively low, Rogers developed a special jig that is larger than the trailer frame itself. That is no small matter since these trailers weigh from 5,250 to 6,500 lb and their decks measure 14 by 8 ft. The jig is used to produce a number of Tagalongs and is then stored in the plant yard until this particular trailer is again scheduled for fabrication.

This jig may be glimpsed in the background of Fig. 5. It sits on steel horses a few feet above the plant floor and essentially resembles a trailer frame in appearance. The big difference is that it has positive stops that form the boundaries for placement of the frame component parts: main beams, outriggers, cross-members and reinforcing channels, all of which have been cut to size in the first bay and roller conveyed to assembly. Some of these members may have had small welding jobs, such as the addition of a wheel housing bracket, already performed on them.

When all of the frame components have been correctly aligned in the jig, air pressure of about 125 psi is admitted to four cylinders located on the jig's open side. Pistons from these cylinders push the positive stops to tighten up the whole assembly. Tolerances of from $\frac{1}{8}$ to $\frac{1}{4}$ in. are allowed in the overall frame. An operator checks to see that pieces are clamped in correct alignment before they are tack welded into place.

Positioning for Welding

The above preliminary assembly operations in the jig are carried out by a crew of four men with the trailer frame in an upside-down position. An overhead crane lifts the tacked frame from the jig and onto one side as shown in Fig. 6. Another crew of four men moves in to anchor the frame with U-clamps, chains and grab-hooks. All possible flat welding is done with the frame in its side position.

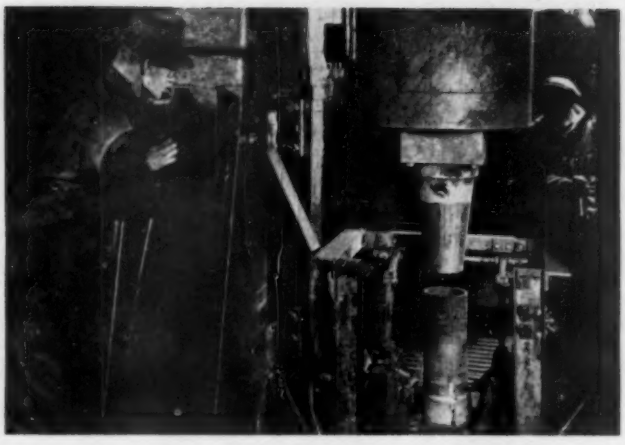
Next step is to reposition the frame to face right-side up as in Fig. 7. Again all possible flat welding is done. The frame is then turned over for finish flat welding on its opposite side. This simple procedure eliminates all but a few vertical welds; where vertical welding is required, it is done by a specially trained man. The welds are visually inspected and rewelded if necessary. They are then smoothed with portable, power-operated grinding wheels before the trailer frame goes to the station for wiring and brake assembly.

In order to test brake assemblies, Rogers developed an ingenious bit of gadgetry. An ordinary milking machine was mounted on a plant-fabricated steel carriage and topped by a vacuum tank as shown in Fig. 8. Hose connections are made from this wheeled vacuum producer, and a set of brakes is tested in a few minutes.

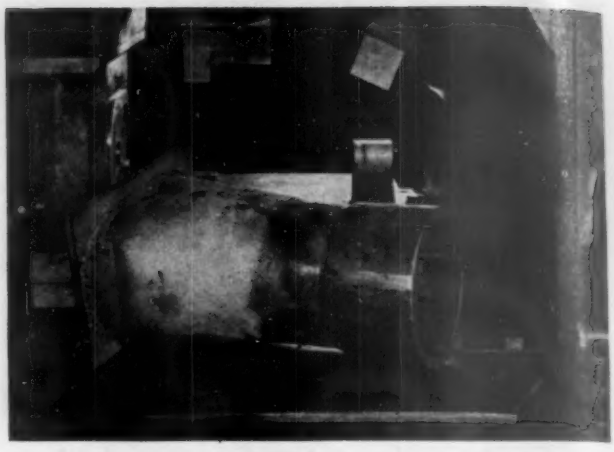
Among other ideas which have saved time and reduced cost is one for welding an end plate to close a length of tubing. The cylinder is placed on a bed of two rollers (Fig. 9) and rotated during welding. Probably nothing very original about this idea, but it can be adapted to many purposes.

One of the most interesting subassembly operations is that of brake-shoe fabrication, done at the end of the second bay. Three men work together in the assembly of brake shoes (Fig. 10). One of these men welds webs and shoes together in a special rotating jig table that positions for flat welding. The welded shoes are taken by the next man, who drills them for rivets and then moves on a few feet to a riveting machine. After the brake lining has been riveted in place, the nearly completed shoe is given to the third man, who trues it on a plant-fabricated sanding machine.

Fig. 8—A milking machine, a vacuum tank and a plant-fabricated steel carriage made this novel mobile tester for trailer brakes



First flaring. Heated white hot, one end of the tube is formed into a flattened ellipse by giant punches



Tubular section after flash welding to base plate. The weld is reinforced by a fillet from the flash.

Flash-Welded Draft Gear

The first draft gear to be made by welding rolled steel is also the lightest ever certified by the Association of American Railroads

A DRAFT GEAR isn't any kind of gear at all but a complex assembly of springs and other components. One of these shock absorbers is installed at each end of the underframe of a railroad freight car in order to take up the tensile stresses created by the pulling of the locomotive and the compressive stresses that occur when two cars are bumped together.

Until recently draft gears were manufactured by assembling cast-steel parts. Now in production, however, is a new model with a housing fabricated entirely from rolled steel. Designed by L. M. Clark, this gear is being manufactured by the Railroad Products Division of A. O. Smith Corp., Milwaukee, and marketed by the Hulson Co., of Keokuk, Ia., and Chicago. The Hulson "Type 202" weighs 202 lb assembled or 404 lb per car set, effecting a saving of 249 lb per car set over the average of other types of draft gears on the market. In a 100-car freight train, the total weight saving achieved by the new type of gear totals approximately 12½ tons.

Manufacture of the weld-fabricated housing at A. O. Smith begins with the production of steel piping in 40-ft lengths. Starting out with an OD of 10¾ in., this pipe is hot reduced to 7⅝ in. OD, which gives it a wall thickness of 7/16 in. The 40-ft sections are cut to lengths of about 22 in., and each length is upset at one end to form an enlarged head, to which an encircling bracket known as the guide support will be submerged-melt welded.

The tubing, the guide support and the base plate components of the housing are all of abrasive-resistant steel (AR), a 2% manganese steel with a carbon content of about 0.45%. The guide support is made by stamping two sections from bar stock and flash welding them together. Four holes for plug welds are punched in each support.

Automatic Plug Welds

Slipped onto the upset head, the guide support is hammered into proper alignment. The welding operator also force fits a ring of alloy material into each of the punch holes. Using the same submerged-melt head, two operators weld two assemblies at a time. While one operator is welding, the other is fitting in the rings or positioning the assembly for his next weld. The plug welds are made to join the prefitted rings to the housing, leaving a certain small degree of freedom between each ring and the support to take up shocks. A bare chromium-steel electrode wire, 3/32 in. in diameter, is used.

The four welds are spaced exactly 90 deg apart. Positioning is very simply accomplished by merely turning the tubing manually on rollers. The welded assembly goes into an induction coil, where a current of 440 volts and 60 cycles heats it to 2,000 F in 45 seconds. It is then soaked for 1½ minutes more in a gas-fired furnace, which it leaves at the lower but uniform temperature of 1,700 F.

Roller conveyors carry the white-hot housing to a large taper punch to be given its initial flaring. It is then reheated and formed into final shape by two other punches. Upon cooling, it is assembled against the base plate without cutting or other preparation. The base plate is ¾ in. thick by 9 by 12½ in. Prior to assembly against the flared end of the tubular section, a boss to hold the retainer bolt is welded to it by the manual arc method.

A First in Flash Welding

Hitherto, flash welding of an end plate of this nature to a tubular section has not been done successfully

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on a production basis. The difficulty is obvious since the tubing is being forced against the plate with great pressure while both are at fusion heat, what is to stop the tubing from going entirely through the plate? The method by which the penetration is controlled is a trade secret. We can say, however, that only a minute or so is needed to make this tricky flash weld and that a current of about 10,000 amp psi is used. The welding process gives the joint a reinforcement of from 25 to 50%.

The flash-welded housing is heated at 1,625 F for two hours—one hour to bring it to temperature and one hour to soak. Lifted from the soaking pit, it is plunged into an oil quench and then drawn at 800 F. The surface is grit blasted and then sprayed with a coat of blue paint.

Beside the housing, the parts involved in the final assembly are: (*a*) one inner and one outer coil spring; (*b*) a spacer, (*c*) an equalizer, (*d*) four shoes, (*e*) a plunger and (*f*) a retainer bolt and nut. Springs, spacer, equalizer and shoes are purchased from outside sources. The plunger, however, is made by A. O. Smith in a 9,000-ton mechanical press—the largest high-speed press in the United States.

Parenthetically, it should be observed that in the Type 202 friction draft gear forged steel works against forged steel for the first time. In previous types of draft gears, a forging works against a casting.

When all components have been assembled, a 1,500-ton press works the draft gear up and down at the rate of 48 times per minute. The shoes rub against the housing and develop enough contact for the required capacity. The resistance that is being built up is measured by strain gauges, readings of which are recorded on an oscilloscope. Inspection is merely a matter of visually comparing the curves that appear on the oscilloscope with permanently marked "acceptable" areas.

As now set up, the A. O. Smith plant is able to produce 2,000 draft gears per month with one shift or 4,000 on a two-shift basis. If these figures seem large, bear in mind that it is the announced goal of American railroads to add 10,000 new freight cars per month, each of which will require two draft gears. Also, replacement business is estimated to equal the requirements for new cars.

Here is the Electrode for strong, machinable cast iron welds

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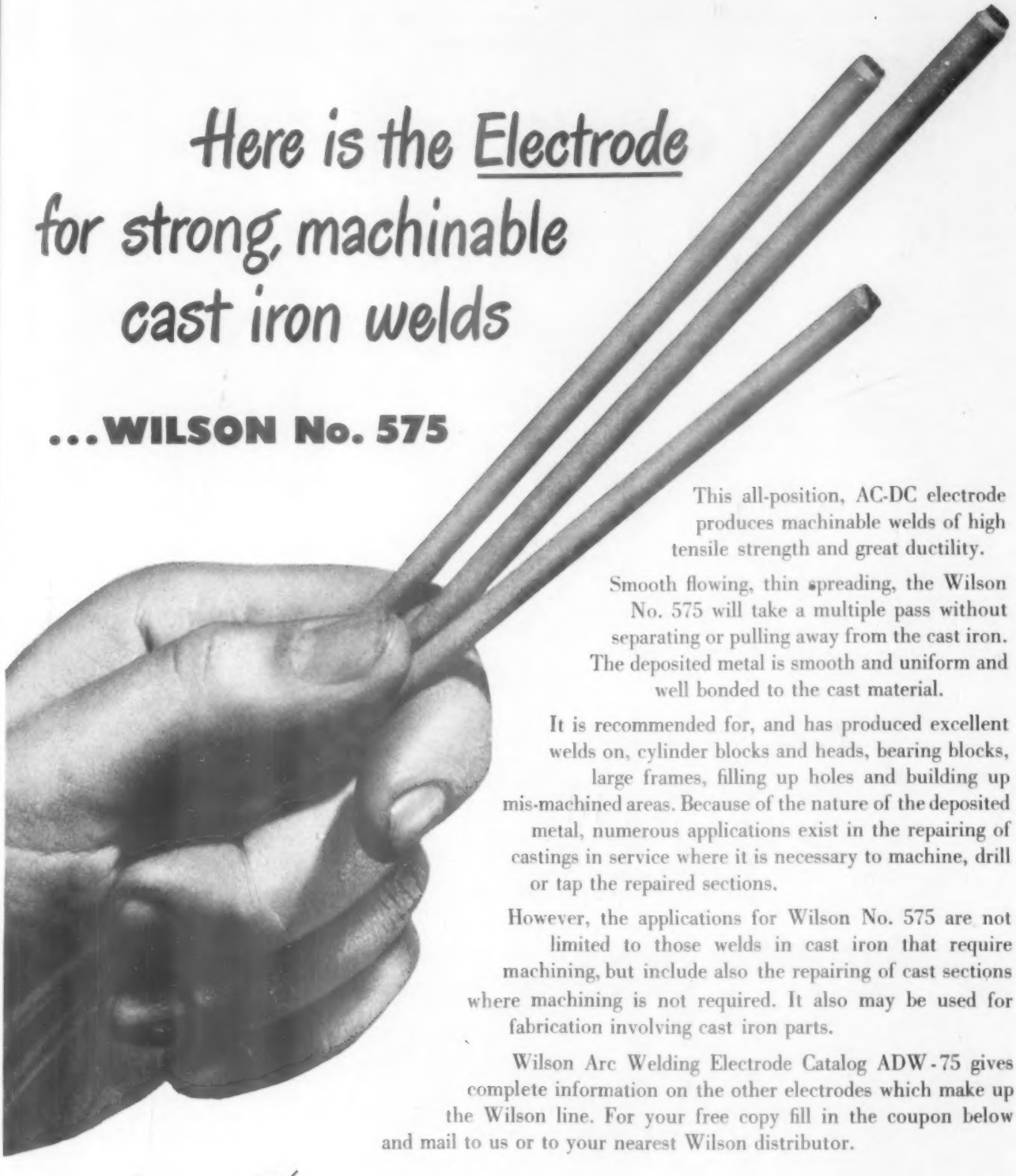

This all-position, AC-DC electrode produces machinable welds of high tensile strength and great ductility.

Smooth flowing, thin spreading, the Wilson No. 575 will take a multiple pass without separating or pulling away from the cast iron. The deposited metal is smooth and uniform and well bonded to the cast material.

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However, the applications for Wilson No. 575 are not limited to those welds in cast iron that require machining, but include also the repairing of cast sections where machining is not required. It also may be used for fabrication involving cast iron parts.

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On the Job

Rotating Freight Cars

WELDING of 40-ton steel hopper cars was greatly facilitated at the Berwick, Pa., plant of the American Car and Foundry Co. by huge positioning fixtures (see picture) on which an entire car could be tipped for downhand welding. Three of these rotating fixtures were used in the construction of 500 hopper cars for the Delaware, Lackawanna & Western Railroad.

Considerable preliminary study was necessary to develop jigs and fixtures that would permit automatic welding of the subassemblies in quantities to meet production-line requirements. The five principal subassemblies are: (1) center sills with draft attachments and ties; (2) upper floor sheet, hopper chute floor sheet and body bolster beam with angle connections; (3) crossridge with cross-bearer; (4) side sheets with top bulb angle, side sill, bolster posts and intermediate posts; (5) end sheet with top bulb angle posts, ladder stile with ladder rounds in place, end sill brake platform brackets and hand brake unit.

Assembly of one of these cars began with the center sill, a member fabricated by welding Z-sections together. After the center sill had been placed on the car trucks, the end-slope, hopper and center-sill roof sheets were fitted at the second assembly station. Then the car ends were brought to the assembly line by an overhead traveling crane and swung into place for tack welding by hand-controlled electric hoists.

The car sides were fabricated as a subassembly on jig positioners. Side posts were spot welded to the 3/16-in. side sheets by a welding gun mounted on a traveling carriage. The sheets were butt welded together, and the completed side was lifted and dropped into position on the previously assembled underframe. The welded sides were held by rivets at the top corners and at the bottoms of the side posts at both ends of the car. Temporary inside braces were added to prepare the car for rotation.

The car as thus assembled was ready to pass progressively through the three welding positioners for the completion of hand welding and final assembly. One side is welded in the first positioner while the car is tipped so that the finish welding can be done downhand. In the second positioner, the car is clamped firmly and rotated 180 deg to an upside-down position in which welding on the underside can be conveniently completed. After it leaves the third rotating positioner, the car is equipped with piping and air brakes and is then rolled off the assembly line for painting.

The rotating positioners in this view are shown looking towards the start of the assembly line

Inside length of the finished car is 34 ft 4 in. and inside width 9 ft 8⅝ in. Height from rail to top of side top bulb angle is 11 ft 0 in. The car has a capacity of 2,221 cu ft level full and 2,399 cu ft with a 6-in. heap. It weighs 39,800 lb, and has a 76.4% ration of pay load to gross load.

☆ ☆

Unless the camera lies, the white-hot steel bar is surrounded by a "hole" in the water

A Hole in Water?

PROOF that a hole can be punched in water is provided by the accompanying picture. The "hole," however, is really filled with invisible water vapor, and it doesn't last long enough for the unaided eye to catch it. The picture was taken with an exposure of 1/10,000 second, using a square bar of white-hot steel in an experimental quenching operation at the research laboratory, United States Steel Corp., Kearny, N. J.

☆ ☆

Cast Iron to Steel

WELDING of cast iron to steel is usually considered a crossed-fingers sort of proposition. The problem came up at the plant of the Jeffrey Mfg. Co., Columbus, O., in the production of guide vane assemblies for the "Aerodyne," a large fan used extensively in mine ventilation.

The guide vane assemblies had to go through no less than 360 operations per fan, including 60 holes drilled in the vanes, 60 pieces of steel cut to size, 12 more holes drilled in the steel strips, 60 rivets to fasten the strips into slots in the vanes—to say nothing of a difficult casting job to put four slots in each vane and the final step of welding the steel strips to the rims. Production would be vastly simplified by welding the 15 guide vanes to the inner and outer rings of the assembly, but the catch was that the vanes were iron castings and the rings holding them in place had been formed of sheet steel.

Experimentally, Jeffrey engineers tried a nickel-base welding electrode developed for cast-iron welding and found that it furnished strong, sound deposits between the iron and the steel. The weld beads run all the way around each corner of each vane and are made without preheat—60 operations replace 360!

Two 4-ft sections of 4-in. pipe make the base of this portable holder. Work is held in the groove between the two pipes

Pipe Holder

By Elton Sterrett

A PIPE-LINE compressor station called for many intricate connections. To simplify positioning, the weldor improvised a holder by spot welding together two 4-ft sections of 4-in. pipe. The outer end of this double cylinder was tack welded to a riser of 8-in. pipe. The free end was either rested on some of the main piping (as shown in picture) or supported on a carpenter's saw horse.

A pipe nipple can be laid in the groove between the two 4-in. pipes and clamped against turning while angles, bevels or other shapes are welded to the protruding end. By loosening the clamp, the work can be readily rotated.

The clamp was made by welding two short sections of ¾-in. rod to a 1-in. nut. The two rods were bent at nearly right angles, and their outer ends were tacked to the outer sides of the two pipe lengths forming the base. A section of 1-in. bolt, long threaded, served as the fastening. A handle was welded atop the bolt to provide leverage.

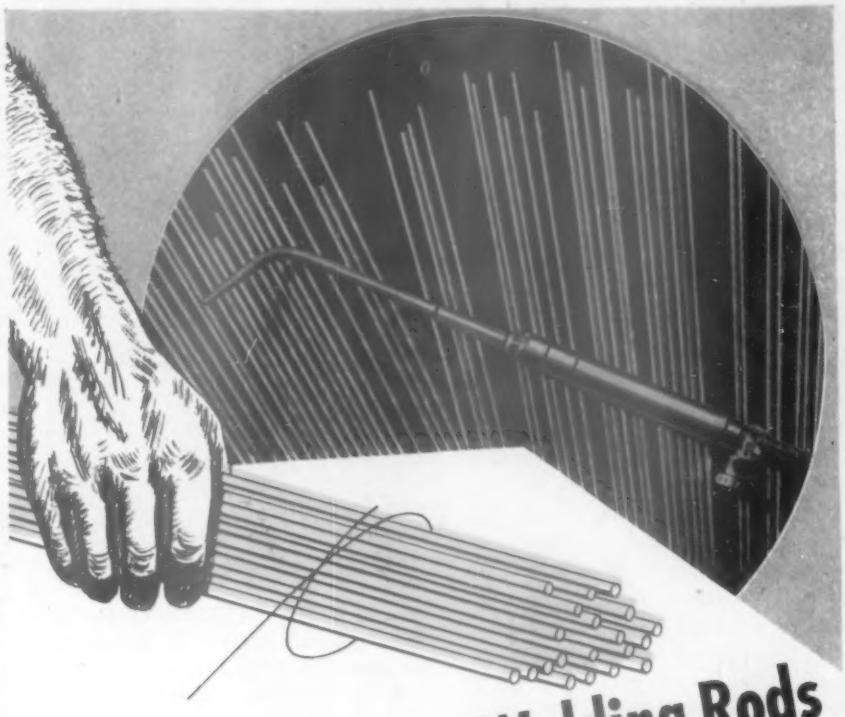
☆ ☆

Spot to Butt Welding

BY ATTACHING an air-clamping fixture to two portable welding guns, mounted in fixed position, Progressive Welder Co., Detroit, was able to devise a stationary butt welder for assembly of universal automotive radiator petcock wrenches. This spot-to-butt-welding conversion enables a production of 150 double-end wrenches per hour to be obtained.

The wrench consists of two U-shaped mild-steel stampings of different sizes, welded one to each end of a bent steel rod. Air-clamping dies of the projection-welder type hold the shank of the wrench while the two jaws are dropped over specially formed electrodes of the two hydraulic push guns. The guns then move the petcock wrench jaws up to the shank under welding pressure to make the series butt welds.

Two operators are used for maximum productivity, one in front of each of the two guns. The first operator loads the wrench shank and one jaw, works the air-clamp control. The second operator loads the other wrench jaw, initiates the welding cycle by pressing the palm switch and unloads the welded wrench.



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CONVENTION NOTE BOOK

(Continued from page 35)

process is indicated for larger sizes. Microscopic studies show that the fusion of the weld faces is complete, the grains having crystallized across the weld line. The duration of heating is very short in comparison with solid-phase pressure welding, usually 5 to 10 seconds, and its control is highly important.

A method of low-temperature stress relieving that makes use of torches mounted on track-traveling carriages was described by R. Kraus, Stacey Bros. Gas Construction Co. These were employed during construction of a 10,000,000 cu ft gas holder at Elizabeth, N. J., and were necessitated by the locked-up stresses in the 2-in.-thick welded plates that make up the lower ring of a tank approximately 276 ft in diameter. The torches provided a ribbon flame 6 in. long to heat each side of the weld to 350-400 F at the surface of the steel. The heating was done both inside and outside the tank simultaneously to gain complete penetration of the steel. Speeds of 8 ipm, 10 ipm and 12 ipm were attained by these traveling stress relievers.

Copper and Super Alloys

A session on research and a session on pressure vessels were also held on Tuesday morning. At the latter session, a paper by John J. Vreeland, Chase Brass & Copper Co., dealt with the successful fabrication of large copper vessels by means of carbon-arc welding. A number of precautions are necessary to observe, including clean surfaces, use of a back-up bar and jigging wherever possible. Vessels of 12-ft diameter or more cannot be jigged because of the high heats that are necessary to weld copper, said Mr. Vreeland.

Of the Tuesday afternoon sessions on research, high alloys and pipe and maintenance welding, there is space to mention only three papers.

C. G. Chisholm, Haynes Stellite Co., discussed recent developments in the use of the so-called "super-alloys" that have made possible the gas turbine. These alloys fall into three general classes, graded according to their working characteristics.

Harold O. Hill (right), AWS president, presents the 1947 honorary membership to J. J. Crowe, assistant vice-president, Air Reduction

Class A alloys of the cobalt and cobalt-nickel base types are the most difficult to fabricate. Class B alloys of the nickel base type, and Class C alloys of the cobalt-nickel-iron base type are not appreciably harder to work than the austenitic stainless steels.

Passing now to an entirely different field, an excellent paper on the organization and work of the plant maintenance weldery was given by Cleo E. Hook, Noblett Sparks Industries, Inc. Such a weldery cannot only perform repair jobs but do construction work that does not involve expensive tooling. Typical jobs mentioned by Mr. Hook were the building of racks, bins, chutes, conveyors, baskets, and trucks.

Maintenance on the Farm

Ernest J. Koop traveled all the way from the Pacific Coast to present his interesting paper on the building, repair and design of farm machinery. Mr. Koop operates the Koop Blacksmith & Welding Shop, located in the country some 25 miles south of Bakersfield, Calif., and he is kept busy from early morning till late night doctoring broken machinery and designing new equipment that will meet the specific needs of his farm customers. His advice on hard-facing is well worth quoting:

"In hard-facing parts of farm machinery, such as plowshares, potato digger blades, cotton sweeps, chisel teeth, sub-soil teeth, planter shoes, etc., best results can be obtained by following the manufacturer's instructions. Then when the part comes back to the shop for repair, watch where the greatest wear has shown. By increasing the width, depth, hardness or toughness of the deposit at the greatest point of wear and decreasing the deposit at some lesser point of wear, the efficiency and life of the part will be increased."

Ship Structure Research

A valuable symposium on ship structure research was held on Wednesday morning under the chairmanship of C. H. Herty, Jr., Bethlehem Steel, and Wednesday afternoon under chairmanship of Earl R. Parker, University of California. The work of the Ship Structures Committee was described by its chairman, Rear Admiral Ellis Reed-Hill, in his introduction to the opening session. Detailed studies were presented by A. Boodberg, H. E. Davis, E. R. Parker and G. E. Troxel, University of California; W. M. Wilson, R. A. Hechtman and W. H. Bruckner, University of Illinois; H. R. Thomas and D. F. Windenburg, David Taylor Model Basin; G. A. Ellinger and Morgan L. Williams, National Bureau of Standards; E. Paul DeGarmo, University of California; E. P. Klier, S. C. Wagner, and Maxwell Gensamer, Pennsylvania State College; Noah A. Kahn and Emil A. Imbembo, New York Naval Shipyard.

Among these 17 authors and their seven papers, we single out Mr. DeGarmo's report on the tests of various designs of welded hatch corners for ships. Of the structural failures which have occurred on welded merchant vessels in recent years, more have originated in the vicinity of hatch corners than at any other single location. It was therefore decided that full-scale laboratory test of welded hatch corners might yield data which would be valuable in designing future welded ships.

Oxy-acetylene and other cutting processes were treated by four papers presented at another Wednesday morning session. D. H. Fleming, Jr., The Linde Air Products Co., told of the production uses of powder cutting, and G. E. Bellew, Air Reduction

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THE SIGHT FEED GENERATOR COMPANY

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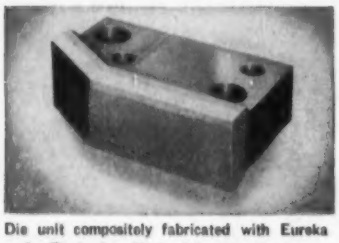
THE PIONEERS of tool and die WELDING ELECTRODES

. . . can help you save 4 ways

Die unit quickly repaired by welding with Eureka Electrodes. No heat-treat required.



Die unit compositely fabricated with Eureka Electrodes. No heat-treat necessary.

Save many man hours, conserve valuable tools and dies and minimize production delays with the aid of EUREKA TOOL and DIE WELDING ELECTRODES. Here's how it can be done:

1 REPAIRING DIES. . . . Existing units that may fail in operation can be EUREKA welded, either partially or wholly, resulting in a minimum of "down-time."

2 COMPOSITE FABRICATING. . . . Die units can be compositely fabricated, when practical, by EUREKA welding, resulting in numerous advantages.

3 CORRECTING DESIGN. . . . EUREKA welding facilitates making changes in contour, corners or edges during die "try-out" or "change-over" periods.

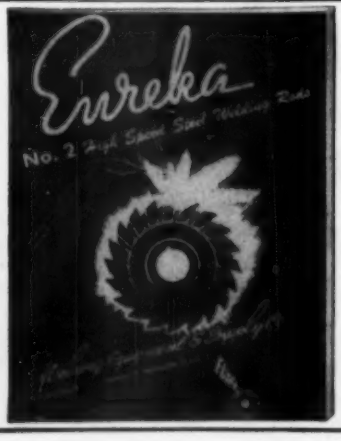
4 RECTIFYING ERRORS. . . . EUREKA welding permits the correction of errors made in tool and die manufacturing, resulting in great savings.

EUREKA ELECTRODES ARE MADE IN THE USA

Welding Equipment & Supply Co.

PIONEERS IN TOOL AND DIE WELDING ELECTRODES

225 Leib Street • Detroit 7, Michigan



NEW EUREKA HIGH SPEED STEEL WELDING RODS BULLETIN

Eureka No. 2 High Speed Steel Welding Rods repair high speed steel cutting tools, compositely fabricate, create cutting, wearing or bearing surfaces. Procedures given.

Welding Equipment & Supply Co.
223 Leib Street,
Detroit 7, Michigan

Rush me Bulletin explaining use of No. 2 High Speed Welding Rods.

Name_____

Address_____

Title_____

City_____ State_____

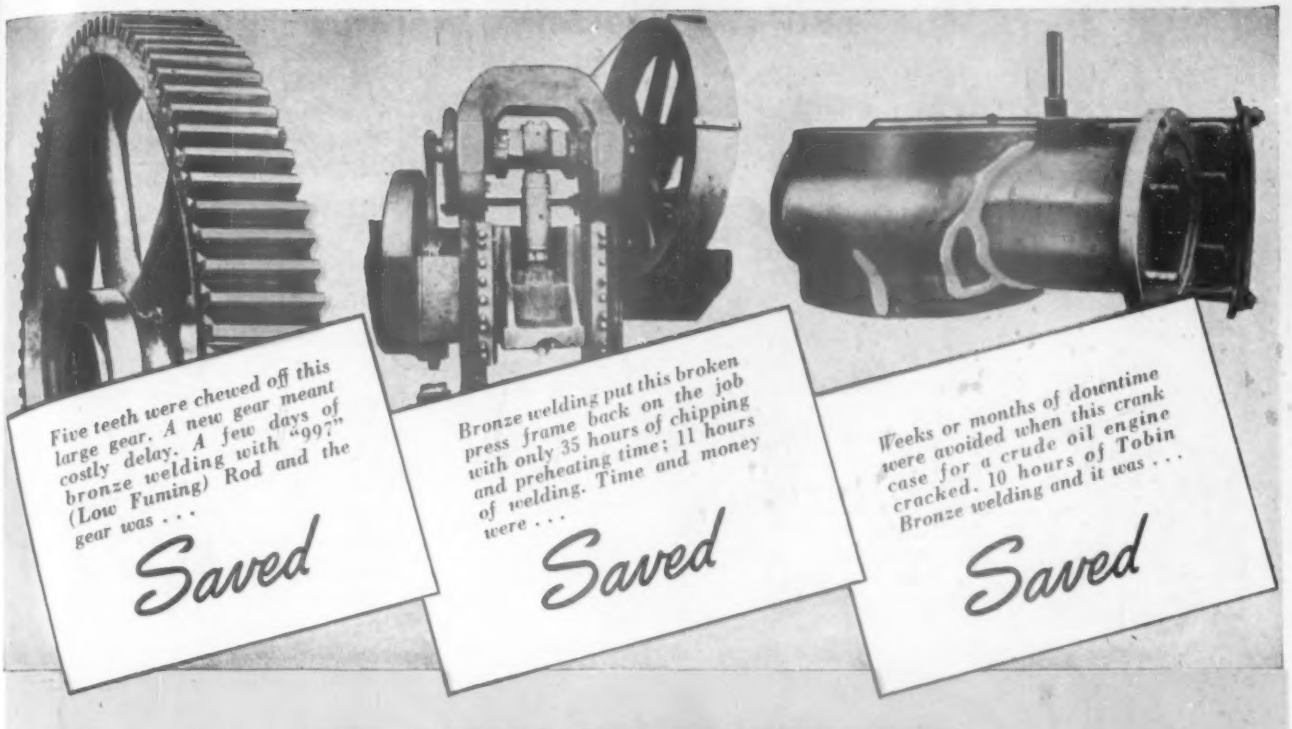
Sales Co., talked on the flux cutting of alloy steels. It is important to distinguish between the Linde powder-cutting process and the Airco flux-injection process since they are different in practically every respect. The powder-cutting process makes use of an iron-rich powder delivered by compressed air to the cutting torch. The flux-injection process employs a dry non-metallic flux and needs no compressed air since the flux is injected directly into the stream of cutting oxygen. A respirator must be worn to protect the operator, which precaution is not necessary with the iron powder process.

The use of a progressive water quench to minimize carbide precipitation in the heat-affected zones of unstabilized stainless steels is now working out very well with both of these flame-cutting processes.

A third new method is the "Oxy-arc" cutting process in which a stream of oxygen is conducted through a flux-coated tubular electrode. An electric arc raises the temperature of the steel to kindling, and the oxygen stream does the actual cutting. A mathematical treatment of the many variables involved was given by Hallock C. Campbell, Arcos Corp. It is Mr. Campbell's contention that the rate of burn-off of the rod is proportional to the electric current and to the cross-sectional area of the core. The rate of cutting, however, is proportional to the rate at which the kindling temperature is established on the surface of the plate. The oxygen requirements are governed by the effective tip size of the tube and the speed and depth of cutting. The predictions of this theory have been helpful in establishing the optimum conditions for cutting various thicknesses of mild steel, but the cutting of non-oxidizable metals is more complex and a more detailed study of its mechanism is needed.

Resistance-Welding Papers

Wednesday was also an important day for resistance welding. Both morning and afternoon technical sessions on this subject were held, and a total of seven papers were read, including the prize-winning one of Julius Heuschkel on the metallurgical aspects of carbon-steel spot welding. G. N. Sieger, S-M-S Corp., was chairman of the morning session, and John D. Gordon, Progressive Welder


Five teeth were chewed off this large gear. A new gear meant costly delay. A few days of bronze welding with "997" (Low Fuming) Rod and the gear was . . .
Saved
Bronze welding put this broken press frame back on the job with only 35 hours of chipping and preheating time; 11 hours of welding. Time and money were . . .
Saved
Weeks or months of downtime were avoided when this crank case for a crude oil engine cracked. 10 hours of Tobin Bronze welding and it was . . .
Saved

BY LOW-TEMPERATURE BRONZE WELDING

HEAVY EQUIPMENT—broken, fractured or worn—goes back to work in days instead of weeks when bronze welded. Well-made bronze welds in cast iron are stronger than the base metal.

There are many reasons for the wide use of bronze welding for joining breaks, mending cracks and building up bearing surfaces and gear teeth. Lower temperatures are used—welds can generally be made by heating only the surfaces of the weld area to a red heat—and there is less chance of warping or cracking. Intricate sections of iron, steel and copper alloys can be joined quickly and economically without dismantling.

Anaconda Welding Rods are available in a wide range of alloys, including Tobin Bronze* and "997" (Low Fuming), suitable for many oxy-acetylene and arc welding purposes. For detailed information, write for Publication B-13, "Anaconda Welding Rods."

47174

*Reg. U. S. Pat. Off.

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THE AMERICAN BRASS COMPANY

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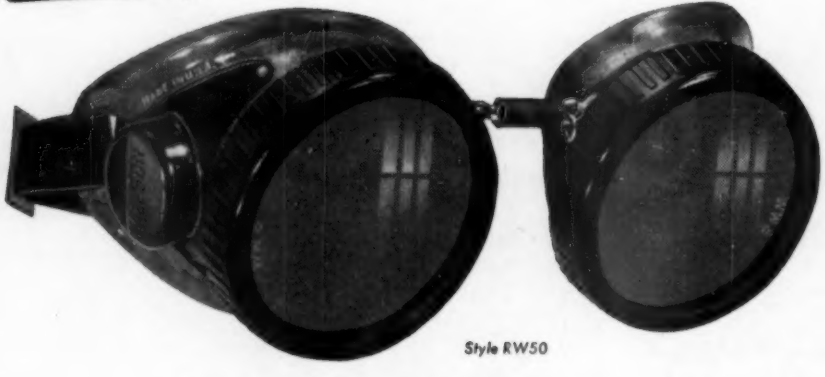

Style RW50

GAS WELDERS GO FOR IT . . . Assured protection of Willson-Weld lenses and comfortable face fit make this goggle day-in, day-out favorite for flame cutting and cleaning as well as welding. Indirect ventilating ports exclude glare.

Style DC50

FOR EYES THAT LEAD A DOUBLE LIFE . . . From welding to chipping with a flip of the wrist! Willson-Weld lenses in separate frames flip up to leave eyes protected by clear, Super-Tough* lenses.

For complete information on these products and their application, as well as many more eye and respiratory protective devices, get in touch with your nearest Willson distributor or write us direct.

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GOGGLES • RESPIRATORS • GAS MASKS • HELMETS

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Established 1870

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Co., was chairman in the afternoon.

Sacred cows were kicked all over the place by the Doty-Childs-Hess report on the fundamentals of spot welding steel plate. W. D. Doty, who read the treatise, is now with the Carnegie-Illinois Steel Corp., while Mr. Childs remains associated with Dr. Hess at Rensselaer Polytechnic Institute. Briefly, the results of their joint research show that, contrary to prevailing belief, pulsation welding does not offer any advantages whatever for the spot welding of steel plates in thickness between ¼ and ½ in. Continuous welding, on the other hand, was found to offer several advantages such as simplified control and the elimination of rapidly fluctuating voltages. A low-current, high-pressure preheat period was found effective in obtaining intimate contact between the sheets and in minimizing short circuiting.

Weld quality can be much improved by accurately considering the factors of shunt path impedance, but the shunting effect is an extremely illusive quality. Robert Blair, The Taylor-Winfield Corp., presented a thorough analysis of shunt path impedance in spot welding mild steel with 60-cycle current as well as with much less complex direct current. It is necessary, insists Mr. Blair, to take into account the relationship of all such variables as welder impedance, electrode voltage, sheet width, spot spacing, sheet thicknesses, sheet temperature and, in particular, the relative position of the shunt path with respect to the welder throat. This is pioneer research of the highest importance.

We come now to the unscheduled surprise paper of T. J. Crawford, consulting engineer of Progressive Welder Co. One of the items previously programed fell through at the last minute, and Mr. Crawford was called upon to fill the breach. His paper, "Resistance Welding Using Kinetic-Energy Storage," described the development of a new type of stored-energy resistance welder that goes back to the oldest principles of electrical engineering: a simple a-c motor, a homopolar generator, a carbon-pile contactor and a flywheel. A homopolar generator, it should be explained, has only one pole—continuous collector rings instead of a commutator—and has been little used since the days of Faraday. Its chief characteristic is that it produces

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Heads in a hurry! Lukens maintains a stock of pressed heads from which we can make prompt shipment of many sizes. And where the heads you need are not on hand, you can order them from Lukens standard stock dies—sizes from 4″ to 108″ O.D.

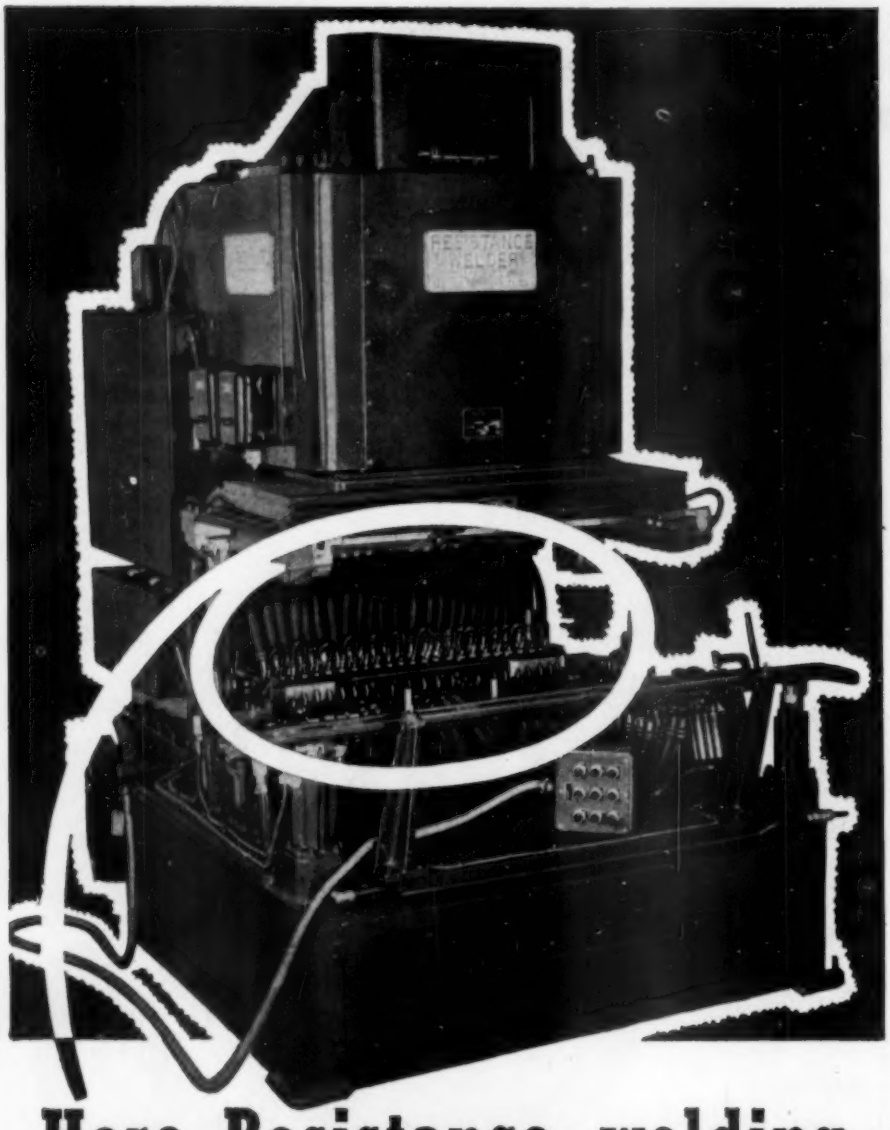
Pressed heads have the advantage of accurate dimensions and uniformity, so your production moves right along without a hitch when you're working with Lukens Heads.

Write for Bulletin 433, giving a complete description of stock heads and ask Lukens to quote on your head requirements. Lukens Steel Company, 416 Lukens Building, Coatesville, Penna.

LUKENS

HEADS

FOUR INCHES TO OVER EIGHTEEN FEET IN DIAMETER



Here, Resistance-welding Costs "Get the Business"

The toughness of Ampco-weld resistance-welding electrodes reduces down-time, increases production, saves money . . .

The machine shown above—and 5 more just like it — must produce 1404 spot welds per minute. They are used by a leading automobile manufacturer to turn out 18 complete underpan assemblies per minute—each pan requiring 78 spotwelds.

Rigorous production schedules such as this, call for trouble-free operation. Ampco-weld resistance welding electrodes are ideal for this kind of service. They combine the hardness and toughness necessary to resist mushrooming and wear, with a high electrical conductivity that resists sticking to the work. Because of these features, Ampcoloy electrodes require less dressing — down-time is greatly reduced; production is increased.

The Ampco line of resistance welding electrodes and alloys is complete. It includes standard and special holders; all products meet R.W.M.A. specifications. Furthermore, Ampco is glad to furnish engineering service for specialized applications. Consult your nearest Ampco field engineer and write for latest bulletins.

Ampco Metal, Inc.

Department WE-12 • Milwaukee 4, Wis.

AMPCO

RW-8

continuous direct current of high amperage and relatively low voltage —just what the doctor orders for resistance welding.

The energy storage of the flywheel and rotor combined is of the order of 2,500 hp-seconds, of which 10 to 20% is available to make the weld. Output of the present pilot machine is between 50,000 and 60,000 amp. It is claimed that this method of energy storage can reduce the peak demand to values of around 5% of that required by ordinary single-phase resistance welders, and that it can be used for spot, projection and flash welding—seam welding is not yet in the picture.

A remarkable feature of the Caputo-Crawford system is that a portion of the weight of the heavy flywheel is carried by magnetic forces. The lifting force on the flywheel removes most of the load from the thrust bearing. This sounds very much like the "anti-gravity" devices of science-fiction writers.

Since this report has already become inordinately long, we can touch on only a few of the papers at the three Thursday sessions. Kudos, however, should be given to R. H. Davies, consulting engineer, The Lincoln Electric Co., for bringing out some important criteria with regard to welded design. There are three types of loading, said Mr. Davies; namely, static, deflection and impact. For static loading, butt welds of 100% penetration may be needed, in which case it is necessary to scarf the plate edges and add new metal at a rate of around 9.8 fph. If the joint has only to resist deflection, however, it is unnecessary to scarf the edges and welding may be done at around 45 fph. To resist impact, it is sometimes necessary to go to the opposite extreme and vee the edges of plates that are to be fillet welded.

Production Stud Welding

Robert C. Singleton, technical advisor, Nelson Sales Corp., discussed some of the new uses that have been found for the production stud welder. In principle, the production stud welder is the same as the familiar portable gun, the fundamental difference being that it is mounted on an automatic positioning device, usually air-operated and electrically controlled. This permits very careful control of stud location. Tolerances of ± 0.005 in. on location and

USE CMD HAMMERS FOR *Every* WELD CLEANING NEED!

TYPE A

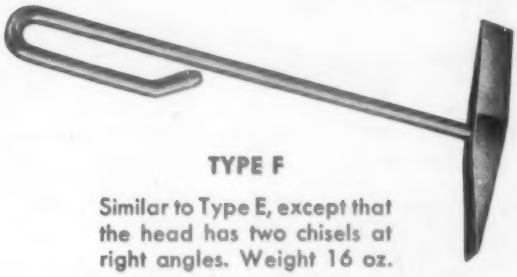
Drift and Chisel. Made from high-grade tool steel. Popular in malleable iron and grey iron foundries for general chipping.

TYPE E

Head made of high-grade ¾ inch square tool steel, has combination drift and chisel for general chipping purposes. Special hand grip absorbs shock. Weight 16 oz.

TYPE CB

Triple Duty. Combines 3 tools in 1—drift, chisel, and removable wire brush.

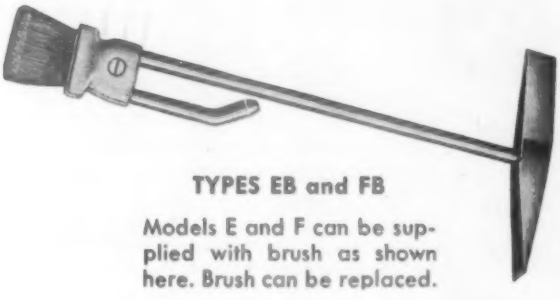


TYPE F

Similar to Type E, except that the head has two chisels at right angles. Weight 16 oz.

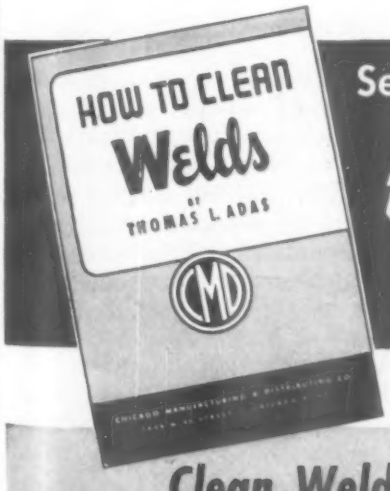
TYPE C

Drift and Chisel. Same as Type CB but without brush.



TYPES EB and FB

Models E and F can be supplied with brush as shown here. Brush can be replaced.



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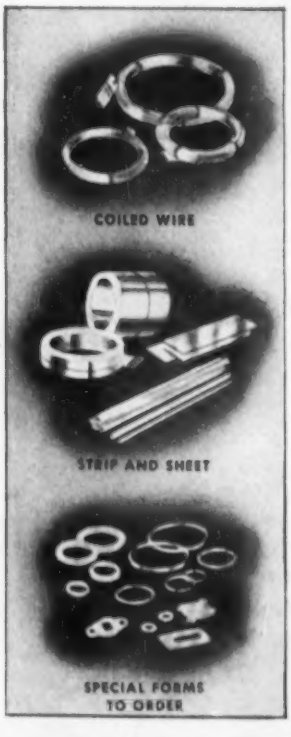

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Day in and day out the automotive, refrigeration, electrical and other industries are using APW silver brazing alloys...and getting good production records, too.

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Contains 45 per cent silver. Exceptionally fast flowing. Our leading alloy for large-scale production.

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Low in cost—high in strength—has 35 per cent silver content.

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A premium alloy for lowest temperature brazing—cadmium-free—highly ductile and corrosion resistant.

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± 0.010 in. in height are possible when the production model stud gun is used with adequate locating fixtures to position the workpiece. From one to six or more stud guns may be used in any unit, depending upon the nature of the job and the production rate required. The operator loads the studs, and ferrules on the workpiece and presses the starter button; from there on the control unit takes over. The guns are automatically positioned, the welds are made and the guns retracted.

Accompanying Mr. Singleton's talk was an extremely good technicolor sound movie on automatic stud-welding applications. This has all the professional finish of a Hollywood production, but it is entirely the work of the Nelson advertising department.

An entirely different type of motion picture, produced by Reid-Avery Co., shows what actually happens in the welding arc. These technicolor camera studies were achieved by running the camera at its maximum exposure speed of 3,200 frames per second. At this terrific speed, the scene is slowed to the point where it is possible for the eye to watch the pulsations of alternating current and note their effect on the arc. This film proves that metal is not transferred in the form of spray—unless it is an "invisible" spray as one member of the audience suggested. The metal seems to drop in large globules from the end of the electrode, but obviously gravity cannot be the only force acting upon it, or overhead welding would be impossible. The true nature of the welding arc is still an enigma.

Welding Special Outlines

Shape-welding by the submerged-melt process was the subject of an excellent paper by J. A. Kratz, The Linde Air Products Co. For the production of irregular or shape welds, a machine is needed that can follow any given outline. This is found in the oxy-acetylene shape-cutting machine, and it is a logical step to mount a submerged-melt welding head upon it.

The combination was used in making a square weld to seal the ends of marine boiler headers, the welding head being mounted on a cutting machine equipped with a magnetic tracer to follow a square template.

An example of more elaborate work is found in the welding head-cutting machine combination used to make the kinds of contour welds encountered in producing furnace shells of light-gauge sheet. Besides the use of cutting machines and templates, the head may be suspended on a pantograph boom that can be guided in any direction over the work. This was done in fabricating a yoke arm for earth-moving equipment. The head was moved manually by a guide wheel, and the operator had to be able to judge the correct welding speed at which to move it.

The weld deposit can also be varied in width by special controls. This is now being accomplished by a large aircraft manufacturer on the long horizontal welds made in propeller blades.

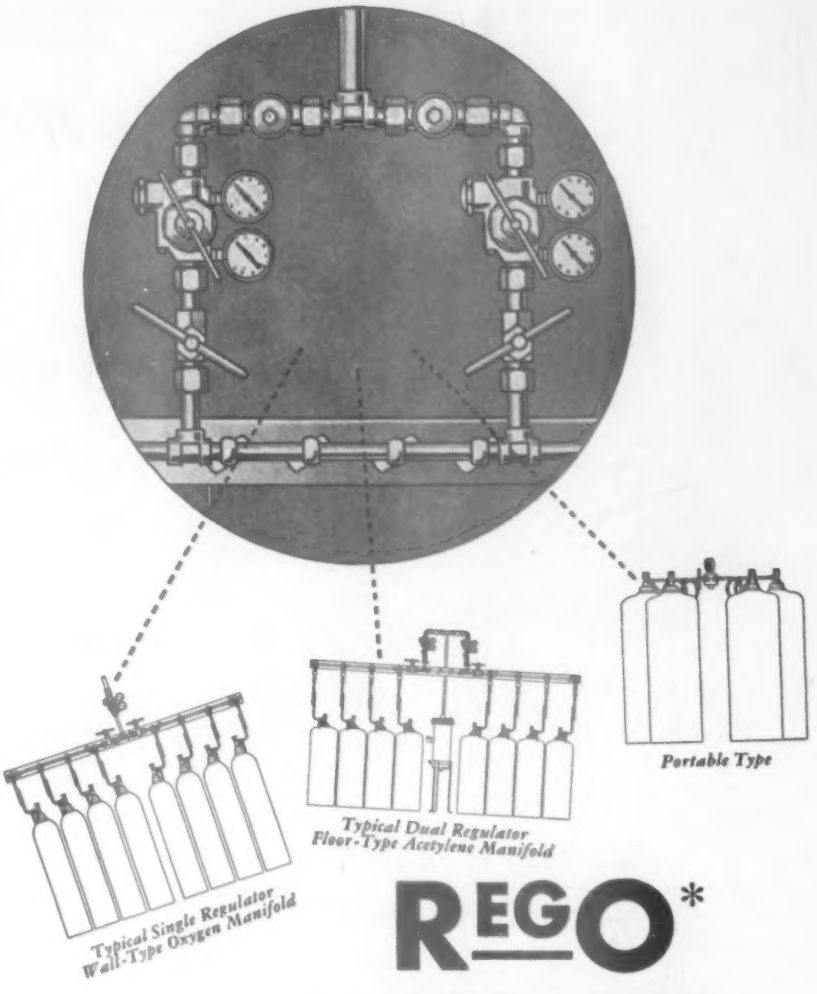
Inert-Gas Arc Welding

A single Friday morning session on inert-gas welding concluded the technical part of the convention. Papers by H. T. Herbst, The Linde Air Products Co., and R. W. Tuthill, General Electric Co., discussed the mechanized method of inert-gas arc welding and some of the latest applications. It is, perhaps, worth mentioning a few of these:

Both aluminum and stainless-steel beer barrels are being welded by the inert-gas process. The fabrication consists of drawing the two ends of the barrel and making one or sometimes two circumferential machine welds in the center.

A fabricator of tubing had his supply of seamless beryllium-copper tubing cut off. Inert-gas equipment was installed on a tube mill, enabling him to weld sheet stock without flux and at high speeds.

A manufacturer of Diesel engines had changed his design to incorporate aluminum pistons. The new design consisted of a cast aluminum body to which a forged aluminum ring had to be shrink-fitted. One-piece pistons were out of the question, both from economy and the difficulties involved. The inert-gas arc process was utilized to weld a sealing bead without filler on the piston head at the joint between the body and the ring. If a welding method using flux had been used, it would have been very difficult to remove the flux from the root of this joint.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Typical Dual Regulator Floor-Type Acetylene Manifold
Typical Single Regulator Wall-Type Oxygen Manifold

REGO* CONSTRUCTION *Produces Better Manifolds*

● RegO design means safe performance, long life and low maintenance costs. Here are some of the construction features you get when you specify RegO Manifolds...

Unit Construction... The header section of each RegO Manifold is virtually one-piece; extra-heavy seamless brass pipe is run through the forged brass header fittings, the cylinder station shut-off valves and the master shut-off valves . . . all permanent connections are then silver-brazed. The header assembly is bolted to a heavy steel I-beam to assure permanent alignment.

Precision Regulation... large capacity two-stage RegOlators assure constant and uniform delivery pressure to the pipe system.

Extra Convenience . . . standard RegO Manifold construction provides individual shut-off valves at each cylinder station . . . this design permits any one cylinder to be disconnected without shutting down the entire manifold. Master shut-off valves control each main branch.

Rigid Tests . . . header pipe, valve bodies and fittings withstand pressure up to 10,000 psi and each complete RegO Manifold is subjected to a sustained air pressure test of up to 2,000 psi.

There Is A RegO Manifold to Fit Your Most Exacting Requirements

REGO MANIFOLDS *for* Oxygen • Acetylene • Hydrogen • Nitrogen *and other high pressure gases*

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Pioneer and Leader in the Design and Manufacture of Precision Equipment For Using and Controlling High Pressure Gases

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Easy slag removal

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1. HAYNES STELLITE Rods . . . cobalt-chromium-tungsten alloys . . . high in red hardness and highly resistant to abrasion and corrosion.
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3. HASCROME Rod . . . iron-base alloy containing chromium and manganese . . . work-hardens under impact.
4. HAYSTELLITE Rods . . . tungsten-base alloy and steel binder . . . extremely resistant to abrasion.
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Specifications for Ferrous Materials

MATERIAL	A.S.T.M.	A.S.M.E. (Boiler)	C. Max.	Mn. Max.	Si. Max.	Cu. Min.	Tensile Kips Min.	Yield Point Kips Min.	Elon. in 2″ % Min.	Red. in Area % Min.	REMARKS
Structural — Bridges, Buildings	A7-46					.20	60/72	0.5 T.S. 33 min.	22		Rolled Steel Base Plates Over 2″ in Thickness C-0.20/0.35%
Mild Steel*	A10-39					.20	55/65	0.5 T.S. 30 min.	24		
Locomotives	A113-46					.20	55/65	0.5 T.S.	22		T.S. for Cars 50/65
Silicon	A94-46				.20 min.		80/95	45	(1)	30	
Ships	A131-46						60/72	0.5 T.S. 33 min.	22		
Boiler Steel — Locomotives Flange	A30-46			.30/.60			55/65	0.5 T.S.	(2)		A30-39 (Firebox), Plates under ¾″, Mn.30-.50% C-0.25%
Firebox (Grade A) Stationary			.30	.30/.60			45/55	0.5 T.S.	(3)		T.S. 48/58 Grade B
Flange	A285-46			.80			45/55	0.5 T.S.	(4)		A70-39, Plates ¾″ and under C-0.25%
Firebox			.30	.80			45/55	0.5 T.S.	(5)		
High Tensile	A212-46										
Grade A			(6)	.90	.15/.30		65/77	0.5 T.S.	(5)		A212-39 Plates 4½″ and under.
Grade B			(6)	.90	.15/.30		70/82	0.5 T.S.	(5)		
Iron Plate	A129-46	SA-129									
Type A			(7)	(7)	(7)		44	27.5	25(8″)		
Type B						.40	44	27.5	25(8″)		
Type C						.20	44	27.5	25(8″)		
Steel for Welding — Flange and Firebox	A285-46										
Grade A				0.80			45	0.5 T.S.	(8)		
Grade B				0.80			50	0.5 T.S.	(8)		
Structural Quality	A283-46T										
Grade A						.20	45/55	0.5 T.S. 24 min.	30		
Grade B						.20	50/60	0.5 T.S. 27 min.	27		
Wire for Concrete Reinforcement	A82-34						80	0.8 T.S.		30	ASA-A50.3-1936
Iron and Steel Chain — Crane, Proof	A56-39			.06							See Specifications for T.S. and Elong. Tests on Finished Chain
Steel Tubes and Pipe — Fusion Welded	A139-46										4″ to 30″ Diameters
Grade A							48	30	30		
Grade B							60	35	25		
Fusion Welded	A134-42										30″ Diam. and Over
Resistance Welded	A135-46										
Grade A							48	30	30		
Grade B							60	35	25		ASA-B36.4-1942
Lapwelded & Seamless Steel and Lapwelded Iron Boiler Tubes	A83-46	SA-83									
Type A, Low Carbon Steel			.08/.18	.30/.60							Flatten., Flange, Crush, and Hydrostatic Tests
Type B, Open Hearth Iron			.08/.18	.30/.60							
Welded Steel Pipe	A53-46										
A. Bessemer							50	30	18(8″)		
O.H. or E.F.							45	25	20		Also Hydrostatic and Flattening Tests
Seamless Steel Pipe											
Grade A							48	30	35		
Grade B							60	35	25		
High Temperature Service — Fusion Welded	A155-42										
Grade A			.17	.30/.60			45	0.5 T.S. 24 min.	(2)		Plates ¾″ and Under C-0.15%
Grade B			.22	.30/.60			50	0.5 T.S. 27 min.	(2)		Plates ¾″ and Under C-0.20%
Grade C			.30	.30/.60			55	0.5 T.S.	(2)		Plates ¾″ and Under C-0.25%
Lapwelded and Seamless	A106-46	SA-106									
Seamless											Also Flattening and Hydrostatic Tests
Grade A			.25	.30/.90			48	30	35		
Grade B			.35	.35/1.00			60	35	25		
Forged or Rolled Steel Pipe Flanges	A105-46	SA-105									
Grade I				.90			60	30	25	38	
Grade II				.90			70	36	22	30	
Carbon Steel Castings for High Temperature Service	A95-44		.15/.45	.50 min.	.20 min.		70	36	22	30	Also Hydrostatic Tests
Wrought Iron — Forgings	A37-39										
For Locomotives and Cars, Class A				.07			45	0.5 T.S.	24(4″)	30	
Misc. Uses, Class B				.15			45	0.5 T.S.	24(4″)	33	
Welded Pipe	A72-45	SA-72		.05			40	24	12(8″)		Also Hydrostatic Test
Iron Castings — Grey Iron Class No. 20 to No. 60	A48-46	SA-48					20/60				The Class No. Designates in Kips the Required T.S.-Transverse Tests Optional
Grey Iron for Valves, Flanges, etc.	A126-42										
Class A							21				
Class B							31				Transverse Test Optional
Class C							41				
Malleable Iron	A47-33										
No. 32510							50	32.5	10		
No. 35018		S-15					53	35	18		

*MILD STEEL: Under the standardization procedure of the Society, these specifications are under the jurisdiction of the ASTM A-1 on steel. These specifications comprise a consolidation of and replace the former Standard Specifications for Mild Steel Plates (A10-39) and for Low Tensile Strength Carbon Steel Plates of Structural Quality for welding (A78-43), which specifications were accordingly discontinued in 1946.

(1) A94-46, Elong., 2″ % min. $= \frac{1{,}600{,}000}{\text{T.S.}}$

(2) A-3046 and A155-42, Elong., 8″ % min. $= \frac{1{,}500{,}000}{\text{T.S.}}$

(3) A30-46, Firebox, grades A and B, Elong., 8″ % min. $= \frac{1{,}550{,}000}{\text{T.S.}}$

(4) A285-46, Elong., 2″ % min. $= \frac{1{,}700{,}000}{\text{T.S.}}$ for material of ¾ to 2 in., inclusive, in thickness a deduction of elongation in 8 in. of 0.125% shall be made for each increase of 1/32 in. of the specified thickness above ¾ in. to a minimum of 22% for flange steel and 23% for firebox steel, Grades A and B; 21% for flange steel and 22% for firebox steel, Grade C.

(5) A285-46 and A212-46, Elong., 2″% min. $= \frac{1{,}750{,}000}{\text{T.S.}}$ on the tension test specimen taken from the top of the firebox plates, shall not exceed 60,000 psi for Grade A, 65,000 psi for Grade B nor 70,000 psi for Grade C.

(6) A212-46 Grade A, C-.33 for plates 2 to 4½″; .31 for plates 1 to 2″; .28 for plates 1″ and under. Grade B, C-.35 for plates 2 to 4½″; .33 for plates 1 to 2″; .31 for plates 1″ and under.

(7) A129-46 total metalloids: C, Mn, P, S, and Si, max %, 0.10 type A, 0.25 types B and C, S, and max % .040 all types; P, max %, .015 all types.

(8) A285-46. Elongation for flange, Grades A and B $\frac{1{,}500{,}000}{\text{T.S.}}$; for firebox, Grades A and B $\frac{1{,}550{,}000}{\text{T.S.}}$

1. Not one, but five separate pic-pointed hammer heads strike with each hammer blow.

2. Free-floating principle spreads the cleaning action over irregular surfaces. Tool steel segments hardened throughout.

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3. Twenty-five pic-points, on five free-floating heads, cleans large areas FAST.

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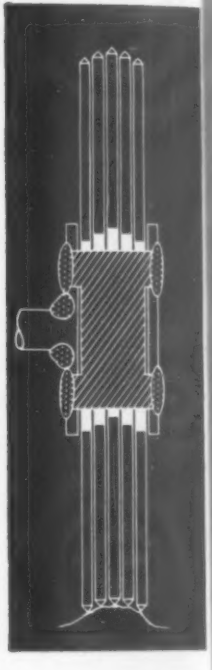

5. Principle of free-floating action. Steel shank (diagonal-lines area) ⅛" x 1¾" passes through 2⅛" slots in the segments to provide the ⅝" free-floating action. Range of free-floating action indicated on white area on each head segment. Note welded construction (dotted areas) for durability.

6. Lock pin prevents handle turning under hard usage.

7. Extra long handle of tough hickory assures perfect balance; insulation against shock.

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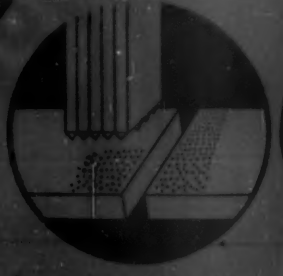

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Using five pic-point head to remove slag from crater during welding.

Multi-Pic easily resharpened on ordinary grinding wheel.

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Fabrication of heavy welded structures is easy and reliable

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News of the Industry

Germans Build Welded Milk Coolers

A DIRECT-expansion stainless steel milk cooler designed for fabrication by welding is one of several interesting items of equipment noted by British investigators in a report on German mineral water and dairy plant equipment manufacturers, prepared for the British Intelligence Objectives Sub-Committee. The unit consists of a header drum about 9 in. in diameter with 34 vertical tubes about 2¼ in. OD and 2 ft, 6 in. long. The milk flows around the drum and down the vertical tubes for collection in a trough. Cooling is accomplished by a direct-expansion flood system.

Orders for the report, "Mineral water and dairy plant manufacturers in Germany" (PB-75848) photostat, $4; microfilm, $2, should be addressed to the office of Technical Services, Department of Commerce, Washington 25, D. C.

☆ ☆

Design New Welder for Clad Plate Manufacture

MEMBERS of the American Society of Mechanical Engineers attending the recent National Conference on Petroleum, learned of an unusual seam welder for the manufacture of composite or clad plates used in pressure vessels. Operation of the new welder, as described by O. R. Carpenter, engineer of The Babcock & Wilcox Co., New York City, is characterized by more consistent welding voltage, considerable power savings and higher current flow into the work for shorter periods. It also helps overcome the problems of shunt currents and contact resistance. Reactance characteristics are extremely low, said Mr. Carpenter, because of the close coupling of the power source to the work. The machine design includes two integral rotary type transformers. The electrode rolls are placed directly within the transformer secondary current carrying members to reduce power losses.

The primaries of the two rotary transformers are connected in parallel; the secondaries, each consisting of a single turn about the primary, are connected in series. The high-voltage winding is supported around the core and consists of pancake coils of square copper tubing. Each coil is of four turns, and the coils are series connected so that the primary consists of 144 turns. Pressure to the welding rolls is transmitted through the transformer mounting by means of the pressure cylinders. A variable-speed drive moves the entire carriage along the cross beam at a fixed rate during welding.

Babcock and Wilcox has also developed a new slabbing process believed to be applicable to most alloys and non-ferrous materials. Thermit powder is ignited over a preheated alloy plate, causing pure iron to be deposited slowly through a flux onto the surface. In traveling through the flux, the thermit metal is cleaned or washed of slag and its temperature is so regulated that fusion of the iron to the alloy occurs evenly over the entire face. Subsequent rolling of the assembled sandwich welds a steel slab to the iron layer which has been fused to the alloy plate.

☆ ☆

Light Metal Clinic Held by Washington State College

MORE than 100 persons attended a two-day light-metals clinic, conducted by the Washington State College division of industrial services and sponsored by the Spokane Chamber of Commerce Industrial development, at the Mead plant of the Permanente Metals Corp., near Spokane.

A. R. Hard, Washington State College welding engineer, directed the clinic, which included morning lectures and afternoon demonstration periods. In advance of the opening, specimens of two typical aluminum alloys and one magnesium alloy were welded and tested at Washington State College. From these specimens it was possible to compare the results of six different welding processes on the three alloys.

The clinic began with a general outline of the properties of the light metals which affect their weldability. Figures such as melting point, specific heat, heat conductivity and specific gravity were presented and discussed. An attempt was made to correlate the effect of these factors with some of the precautions that are necessary in this type of welding.

Discussion then turned to test results on a heat-treatable aluminum alloy, a work-hardenable aluminum alloy and a work-hardenable magnesium alloy which had been welded by several different processes: None (Parent metal), Two-row spot weld, Flash weld, Seam weld, Inert-gas, Metal-arc, Metallic Arc and brazing. The welded joints showed tensile strengths that ranged from 37 to 89% of the parent metal.

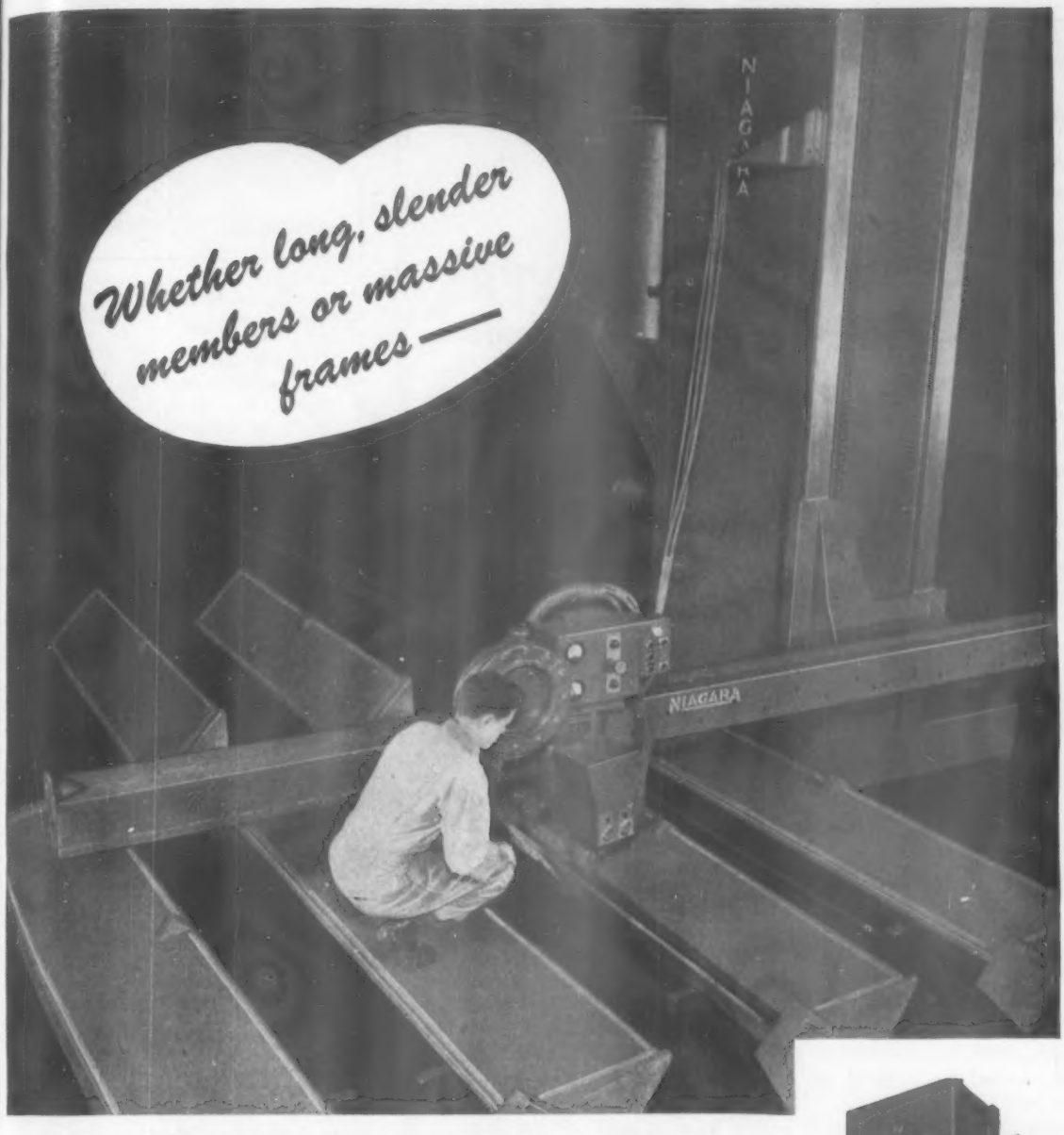
Ed Bennett, service engineer for the Linde Air Products Co., discussed inert-gas welding, while J. W. Dickson, process service supervisor for the same company, demonstrated manual argon-shielded arc welding of aluminum and magnesium. T. S. Sholes of Gibson Welding Supplies, Spokane, demonstrated metal-arc welding of aluminum, while Washington State College staff members demonstrated automatic argon-shielded arc welding of aluminum and also gas welding and brazing of this metal.

☆ ☆

Test New Furnace at Carnegie-Illinois Steel

SPEARHEADING the research efforts of the United States Steel Corp., a 122-ton furnace at the South Chicago Works of Carnegie-Illinois Steel Corp., will soon be trying out the fastest known methods to make open hearth steel. Numerous innovations in refractory brick have been employed to weather the unusually high temperatures associated with experimental speed-up processes.

Bent heads show the interest manifested in the light metals clinic, conducted by Washington State College at Spokane, Wash.



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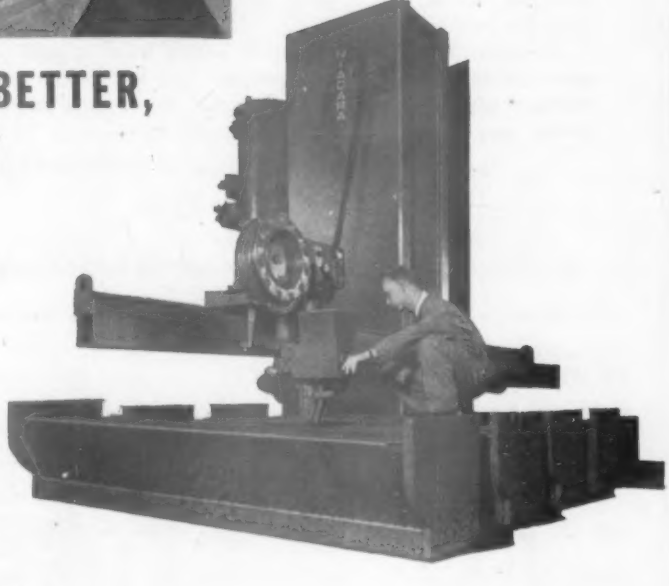

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Australians Invent Welding Timer

A NEW electronic timer for resistance welding has been developed by the E. M. F. Electric Co., Pty. Ltd., Melbourne, Australia. It is designed to time two alternately occurring operations and consists of an electronic tube with one or several controlling electrodes and a device to impart a negative bias to a controlling electrode. This device becomes operative when the tube is not conducting and the negative bias is reduced when the tube is conducting. A capacitor imparts a positive potential to a controlling electrode and is charged progressively until the tube commences to conduct. When the capacitor is discharged to its initial stage, the tube ceases to conduct; timing interval is governed by the time the capacitor is set to charge and discharge.

Another Melbourne firm, Quasi-Arc Pty. Ltd., has developed a recording device for arc welding. It operates by integrating the period during which the arc voltage is maintained between predetermined minimum and maximum values. The recorder is connected to a source of energy independent of the welding circuit and also to a relay system associated with the welding circuit. The transmission of energy from the independent circuit to the recording apparatus is interrupted whenever the arc voltage falls outside the preset values.

☆ ☆

Spiral Tubing Made by New Organization

WILEY W. MCMINN and OLOF BRANT, formerly vice-president and chief development engineer, respectively, for Agaloy Tubing Co., have organized their own firm, B & M Mfg. Co., Grand Rapids, Mich., and East Orange, N. J., for the manufacture of "Spiralock" tubing. This product has an interlocked spiral joint and can be made from strips of any desired material —carbon steel, galvanized iron, stainless steel, Monel, clad strip, etc. It is not recommended for carrying liquids or gases under pressure or for applications where it must be bent.

☆ ☆

Materials Handling Show In Cleveland, Jan. 12-16

ONE-HUNDRED and fifty exhibitors have contracted for booth space at the National Materials Handling Exposition to be held Jan. 12-16 in Cleveland's public auditorium. This is 90% more than the number represented at the first show a year ago, which had an attendance of 12,000.

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THE NEW LINE OF P&H "Dial-lectric" CONTROL WELDERS

Are you paying for walking time or welding time? P&H's simplified *"Dial-lectric"* control eliminates wasted steps. The *"Dial-lectric"* unit can be removed and used any distance from the welder — an extension cord is all that is required. And you get better control, better welds — the operator can "snuff" out his arc at will, craters can be eliminated.

Are you cramped for floor space? This New P&H Transformer Welder can be located up, out-of-the-way.

Is maintenance cost and down time a problem? This new welder eliminates all wear and lubrication — there are no moving parts.

Plan cutting your welding costs the new *"Dial-lectric"* way. See your P&H representative or write for Bulletin W-72.

NO OTHER AC WELDER HAS ALL THESE FEATURES

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Now you can get *"Knock-Out"* welders built to R. E. A. specifications for rural use. Ideal for farm or repair shop. They will repay their costs many times by making handy farm machines.

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Train Distributors at Arcrods Corporation

To keep G-E welding distributors and their specialist salesmen posted on latest developments, General Electric's electric welding division is sponsoring a training course at the Arcrods Corp., Sparrows Point, Md.

Students are trained for a week in this course, which is under the supervision of J. H. Humberstone, vice-president of Arcrods and H. O. Westendarp, Jr., manager of sales of G-E electrodes. Sessions consist of blackboard lectures by E. B. Lutes, welding engineer of Arcrods Corp., followed by demonstration periods in welding booths.

☆ ☆

Square D Co. Establishes General Sales Department

To coördinate sales promotion, advertising and overall sales policies, the Square D Co., Milwaukee, has formed a general sales department headed by L. W. Mercer as general sales manager. Mr. Mercer will also continue as general manager of the switch and panel division in Detroit. F. H. Roby has been appointed assistant general sales manager, C. L. Hull, sales manager of the switch and panel division. Both men continue their other duties.

☆ ☆

To Build 36 Tank Cars of Welded Construction

SHELL Chemical Corp., San Francisco, has placed an order with American Car and Foundry Co., for 35 new all-aluminum gas tight tank cars for the transportation of synthetic glycerine. Both tanks and under frames will be of all-welded construction. The new cars will be built at the Milton, Pa., plant of ACF, where they will be welded by a special gas-shielded arc process. Seams will be checked by X-rays.

☆ ☆

Welded Gas Tanks for Kaiser-Frazer Cars

WHILE setting its sights for production of 1,500 automobiles a day by early spring, Kaiser-Frazer Corporation's subsidiary, Permanente Metals Corp., has developed a new aluminum utility sheet to replace steel. First use will be in the manufacture of seam-welded gasoline tanks. The welded aluminum tank will weigh 7 lb and hold 21 gallons while a steel tank of comparable size weighed 22 lb. Figured on a production basis of 1,500 cars a day, almost 17 tons of critical steel will be saved.

☆ ☆

Purdue Conference December 4 and 5

PURDUE University will hold its 19th annual welding conference, March 4 and 5 at Lafayette, Ind. Manufacturers, distributors and users of welding and welding equipment are invited to attend. The program is arranged to cover a full range of interest in the welding field.

Eastern Distributors Hold First Meeting

EASTERN zone of the National Welding Supply Association held an organization meeting at the Pennsylvania Hotel, New York City, on November 5. The meeting was called to order by J. W. Albiston. The Main Oxy-Acetylene Supply Company, Auburn, Maine, who is vice-president of the eastern region of the National association.

R. C. Fernley, secretary-treasurer of NWSA, outlined the objectives of the association. He pointed out that the association could readily develop more friendly business relations and better trade practices for the distributors, and that in doing so it should improve welding industrial relations at all levels. Considerable discussion followed regarding the relationship of the manufacturer to the distributor. Several of the manufacturers present spoke up to say that manufacturers have problems just the same as distributors do, and that a better understanding could be obtained all around by cooperative association work. The outcome of the morning's activities led to a suggestion that the association make trade surveys, study and analyze the findings and distribute the resulting information to its membership.

Robert Waldie, Williams and Company, Inc., Pittsburgh, led a discussion on distributor salesmen and their compensation, which topic gradually diverged to the relationship between the distributor salesmen and the manufacturer's salesman and technical men. It was suggested that the association conduct a survey on the question of compensation to salesmen.

Following an excellent luncheon, the general inventory situation of the welding distributor was reviewed under guidance of L. E. Johnson, Welder Supply Company, Boston. It was the consensus of opinion that inventories bear very careful watching and that they should not be allowed to get out of hand. Several members described the inventory system they were using, giving the members the benefit of a variety of inventory methods.

The closing activity of the afternoon was a group discussion on advertising led by Secretary Fernley. Several worthwhile suggestions were presented as to the means of obtaining most effective advertising.

Effects of advertising freight rates were also taken up. It was the feeling of the majority of those present that this increase in costs was a matter of genuine concern to all welding distributors.

The delegates attending the eastern zone meeting included: R. P. Mahoney, Albany Welding Supply Co., Albany, N. Y.; E. J. Rosser, Aldan Welding Supplies, Philadelphia; E. J. Brady, Alloy Rods Co., York, Pa.; Thomas E. Berry, Bent Laune, Richard H. Mandel, Arthur N. Rubin, Richard T. Spear, V. H. VanDiver, All-State Welding Alloys Co., White Plains, N. Y.; James E. Norcross, Arcos Corp., Philadelphia; Joe Beckett, Allentown, Pa.; Tom Butler, Butler Cylinder Gas Co., Reading, Pa.; Frank P. Marcus, Eastern Welding Equipment Co., New York City; A. C. Axtell, Essex Welding Equipment Co., Inc., Newark, N. J.; A. E. Zeisel, Howard L. Edsall, J. E. Jackson, Niel O'Niell, R. D. Wasserman, Eutectic Welding Alloys Corp., New York City; E. R. Joseph; Norristown, Pa.; J. P. King, The Alfred B. King Co., New Haven, Conn.; J. W. Albiston, Maine Oxy-Acetylene Supply Co., Auburn, Maine; R. S. McCracken, Jr., C. H. Buek, R. S. McCracken & Sons, Inc., Philadelphia; L. F. Moss, John Nageldinger & Son, Inc., New York City; Richard A. Harvey, New England Welding Supply Co., New Haven, Conn., G. E. Lowrie, New York Welding Supply Co., New York City; J. J. Walsh, Clinton N. McElheney, Page Steel & Wire Div., American Chain & Cable Co., New York City; Cornelius J. O'Callahan, Pennsylvania Welding Supply Co., Philadelphia; P. K. Connelly, Edward C. Madison, Presto-O-Sales & Service, Inc., Long Island City, N. Y.; Harry Nash, James C. Miller, Revere Copper & Brass, Inc., New York City; C. P. Weber, Weber-Semmer Co., Pittsburgh; Carl W. Berner, Welders Supply, Philadelphia; L. Everett Johnson, Welders Supply Co., Boston, Mass.; Gove Mitchell, The Welders Supply Co., Scranton, Pa.; A. E'Espies, Welding Alloy Manufacturing Co., Newark, N. J.; T. B. Jefferson, Clyde B. Clason, T. E. Depew, C. H. Clark, John F. Doyle, THE WELDING ENGINEER, R. C. Waldie, Williams & Company, Inc., Pittsburgh; Robert C. Fernley, National Welding Supply Association, Philadelphia.

☆ ☆

New Oxygen Plant Built in Arizona

CONSTRUCTION of a $225,000 plant for the manufacture of oxygen and acetylene has been started in Phoenix, Ariz., by the Dye Oxygen Co. Production goal is 6,000 cylinders of oxygen and 2,000 cylinders of acetylene per month. The giant mining industry of Arizona has been pegged as one of the biggest customers of the firm.

Executives of Dye Oxygen are: Gil V. Dye, president, B. L. Thomas, plant superintendent and vice-president; N. L. Meyers, office manager; Mrs. Ruth Dye, secretary-treasurer.

☆ ☆

Magnaflux to Hold Inspection Conference

MAGNAFLUX CORP., Chicago, will sponsor a three-day Weld Inspection Conference in the auditorium of the Southern California Gas Co., Los Angeles, on December 4 and 5. On Saturday, Dec. 6 guests are invited to visit the Magnaflux laboratory in order to see a demonstration of equipment and methods.

☆ ☆

Welding Man Elected Head of SBMA

L. O. (HEINIE) SCHNEIDERWIND, president of the Omaha Welding Supply Co., was recently elected president of the Nebraska Small Business Men's Association at the groups annual convention.

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No. 18C FLUXINE for gas and atomic hydrogen welding of stainless steels and inconel.

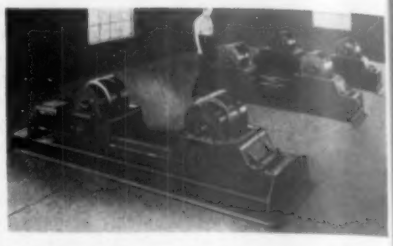
No. 41 FLUXINE used with high-melting silver solders on copper and its alloys and on steel.

No. 42 FLUXINE used with Westinghouse Phos-Copper rods and low-melting silver solders on copper and its alloys.

No. 43 FLUXINE . . . non-glaring . . . used when low-melting silver solders are specified. No injurious fumes. Goes further than most fluxes.

FLUXINE
TRADE MARK REGISTERED U. S. PAT. OFF.
FLUXES TO JOIN
ALL METALS

New Products to Use



Turning rolls for welding cylindrical shapes

Turning Rolls

Two new power-driven turning rolls, Models 250 and 500, have capacities of 25,000 and 50,000 lb., respectively, and are used to rotate tanks and other cylindrical shapes for either manual or automatic welding. Equipped with a variable-speed drive and remote control switch, each model is of welded steel construction and has totally enclosed gearing. Separate power and idler units increase flexibility, and extra idler stands can be used to gain up to 50% additional capacity. REED ENGINEERING CO., West Fairview Ave. & Mo. Pacific R.R. Carthage, Mo.

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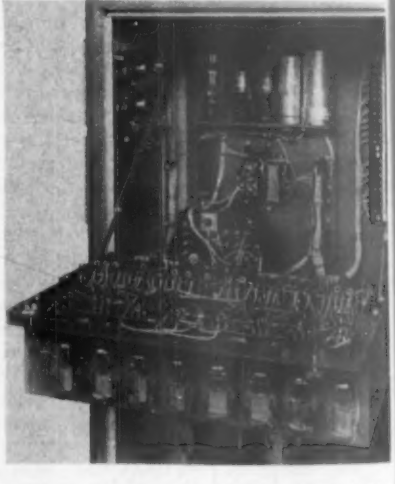

NEMA type N3, size 1 combination control. The control continues to operate with timer panel open for inspection

Resistance-Welder Controls

In the new line of Taylor-Winfield controls for resistance welding, accurate timing is provided by d-c timing circuits which operate on closely regulated bias and timing voltage to compensate for variations in power-supply voltage. These non-synchronous coördinated controls have separate timing dials graduated in cycles for squeeze, heat, cool im-

pulse, hold and off periods. An important feature for pulsation welding is that the impulse timer dial is graduated directly in the number of impulses desired (no adding of heat and cool periods by operator).

Control units are readily accessible through the large side door of the cabinet. The panels on which the components are mounted are designed to swing downward for ease of checking and servicing. To facilitate servicing, the entire panel can be lifted out and replaced with a spare panel. Marked terminal strips and lead tabs, together with prepared test points and circuit points, provide for efficient trouble shooting. Plug-in type connections make quick changing of timing panels and power chassis possible. Drainage is provided in bottom of enclosing case for any condensation from the water-cooling unit. A low-voltage (24 volts) initiating circuit is included as a standard feature.

Each control is a compact packaged unit, factory assembled and tested with welder or mounted on a welder when so ordered. As installed, the control is within easy reach of the operator with the adjusting dials always facing him for quick inspection of settings.

These non-synchronous controls are available for operation on single-phase alternating current at control voltages of 110, 208, 220, 380, 440 and 550 volts and power-supply voltage of 208, 220, 380, 440 and 550 volts. TAYLOR-WINFIELD CORP., Warren, O.

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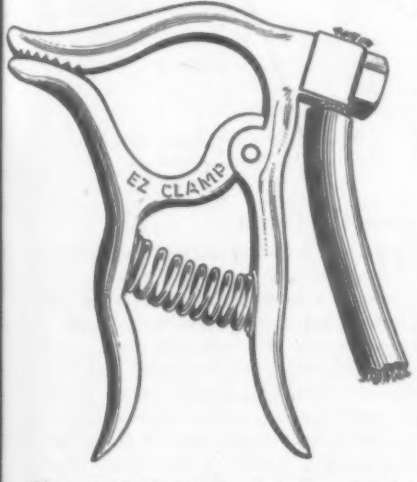


"EZ" ground clamp makes for easy connection of cable. Current travel is short

Ground Clamp

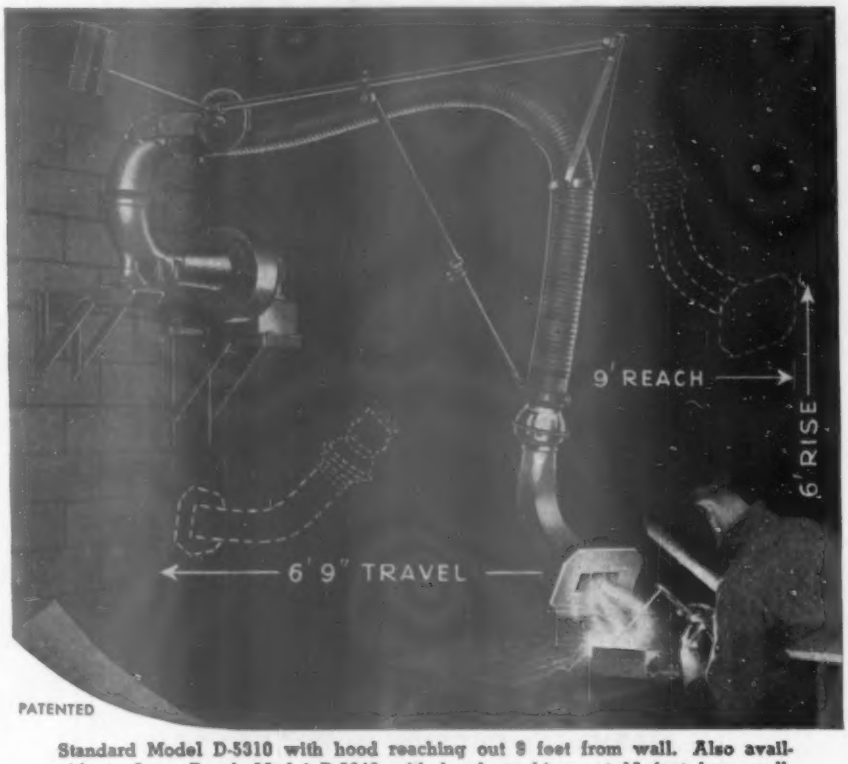
HEATING is eliminated in a new ground clamp, which is designed so that current has to travel but a short distance in the clamp before grounding. Rigid handles make the clamp easy to use, and its sharp teeth remove rust, paint and scale to assure a positive ground.

Outstanding feature of this clamp is the provision for connecting the grounding cable. Cable may be connected by means of a lug, the solderless connection furnished with the clamp, or soldered directly to the ground clamp as user prefers. WILL-WELD MFG. CO., INC., 600-620 S. 15th St., Omaha 2, Neb.

"I WORK IN CLEAN FUME-FREE AIR —thanks to our RUEMELIN FUME COLLECTOR"

Welding shops equipped with Ruemelin Fume Collectors are assured of a clean shop atmosphere. Noxious fumes, heat and smoke are eliminated *at their source*, thus improving working conditions, lessening fatigue and paving the way for increased plant production.

The Ruemelin Fume Collector hood can be instantly placed where needed anywhere in the booth welding area. No tedious adjustments necessary. Just pull the inlet hood to the welding position and you are ready to go. Approved by state industrial commissions and by compensation insurance companies. Simple to install. Thousands in service. Many users send in repeat orders. Write for bulletin 37-C today.



Standard Model D-5310 with hood reaching out 9 feet from wall. Also available in Long Reach Model D-5342 with hood reaching out 15 feet from wall.

RUEMELIN MFG. CO.

3880 NORTH PALMER STREET • MILWAUKEE 12, WISCONSIN, U. S. A.

MANUFACTURERS AND ENGINEERS • SAND BLAST AND DUST COLLECTING EQUIPMENT • WELDING FUME COLLECTORS

CHEK-SHOCK OXYGEN CUSHION VALVE

SOFTLY controls the vicious "jolt" of high pressure oxygen gas, thus eliminating regulator repairs and preventing possible injury to operators.

- Will allow tank valve to be opened rapidly without damage to regulator or danger to operator.
- Will increase life of regulator assembly.
- Will eliminate possible injury to operator from burstings.
- Will prevent unnecessary internal wear in regulator (*as NOT necessary to release control screw before opening tank valve*).

PRICE IS LESS THAN ONE REPAIR BILL ($6.00 EA.)

#1. STANDARD COUPLER . . . for all standard size welding type oxygen regulators.
#2. LIGHT COUPLER . . . for "airplane" or soldering size oxygen regulators.
#3. HEAVY DUTY COUPLER . . . recommended for extra heavy duty work only.
#4. SCREW TYPE COUPLER . . . for removable inlet stem regulators (¼" pipe) available in standard, light, or heavy capacities.
#5. FOR HYDROGEN . . . left hand thread coupler.

We also Make MEDICAL CHEK-SHOCKS for All Types of Medical Regulators and Tank Fittings (chrome plated)....$8.00 Ea.

SEE YOUR DISTRIBUTOR OR WRITE—

Chek-Shock MFG. CO.
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EFFICIENT
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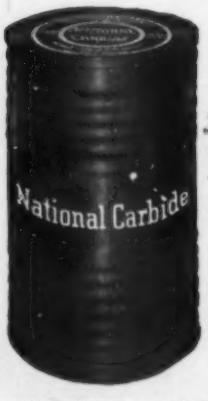

NATIONAL CARBIDE IN THE RED DRUM

Write us for information as to nearest available stock.

NATIONAL CARBIDE CORPORATION
60 E. 42nd St., New York 17, N. Y.

Dispenser for silver-brazing alloy. A recess in the middle carries the flux jar

Brazing-Alloy Dispenser

Two types of silver-brazing alloys are now being packaged in an aluminum dispenser, the center of which is recessed to carry the flux jar. The alloy, in 1/16-in. wire and 10 and 20 ft. lengths, is coiled around the core and is drawn out through the edge while the dispenser is being held in the hand during brazing. Use of the dispenser provides accurate amounts of flux and alloy. The alloys so packaged are No. 100 "high-strength" and No. 111 "lowest-melting-point," each available in both 10 and 20 ft. lengths. All State Welding Alloys Co., Inc., 96 W. Post Road, White Plains, N. Y.

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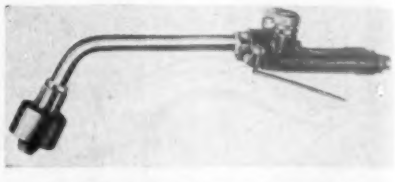

"C-47" torch for heating, annealing or soldering operations

Gas-Air Torch

Designed for use with manufactured gas or propane and compressed air, the new "Weldimatic C-47" torch automatically reduces the flame to a small pilot light during idle moments. When work is resumed, the torch relights instantly to the original adjustment. It is made of special aluminum alloy and a long lever provides easy flame control regardless of the position in which it is held. Special control adjustments compensate for fluctuating gas and air flow both on the pilot light and main flow. Weldit Inc., 990 Oakman Blvd., Detroit 6.

☆ ☆

Low-Temperature Electrode

Eutectrodes "67 AC" and "670 DC" are two new low-temperature electrodes for joining, filling, filleting and overlaying all types of alloy steel where high tensile and impact strength, corrosion and wear resistance and high hardness values are required. They can also be used to deposit overlay on cast iron. These new electrodes for a-c (67 AC) and d-c (670 DC) are available in 3/16, 5/32, 1/8 and 3/32 in. diameters. Eutectic Welding Alloys Corp., 40 Worth St., New York City 13.

This 200-amp d-c welder is offered in stationary or portable models

200 Amp D-c Welder

DESIGNED for 200 amp at 30 volts on the basis of a 50% duty cycle, the new engine-driven d-c "Ranger" can be mounted on a trailer for field work or used in the shop for welding steel, cast iron, alloys, hard-facing aluminum and brass. Current is adjustable over a wide range extending from 30 amp at 20 volts to 250 amp at 30 volts. Four major settings are obtained by plugging screw locking plugs on work and electrode leads, rheostat control provides intermediate current values. Each welder comes with work and electrode leads, helmet, electrode holder, cleaning brush and a supply of electrodes. WESTINGHOUSE ELEC. CORP., P. O. Box 868, Pittsburgh 30.

☆ ☆

All-Position Electrode

TWO advantages of the improved Wilson "512" all-position, mild-steel electrode over its predecessor are: (1) it can be used on a-c or d-c, reverse polarity with equal operating characteristics, (2) preheating is not required to obtain porosity-free weld deposits.

Recommended applications for this improved electrode are: welding high-sulphur, free-machining steels; welding hardenable steels where no preheat is used; welding cold-rolled steels which normally exhibit excessive porosity when welded with conventional electrodes; on weldments to be vitreous enameled after welding. The low hydrogen content of this electrode is said to make possible the production of satisfactorily enameled surfaces without any heat treatment prior to enameling. WILSON WELDER AND METALS CO., INC., 60 East 42nd St., New York City 17.

☆ ☆

Air Cleaner

POWERED by a 1½-hp motor, the new "Ideal" heavy-duty cleaner blows air at a velocity of 25,500 fpm. It can be used either to vacuum clean or to blow out dirt, the former being the preferred method of cleaning since it transfers the dirt into a bag. If drying action is desired, a heater nozzle may be attached.

A medium-duty cleaner, which operates the same as the heavy-duty model, has a ⅔-hp motor that displaces air at a rate of 19,000 fpm. IDEAL INDUSTRIES, INC., 1935 Park Ave., Sycamore, Ill.

Courtesy of The Hebart Bros. Co.

speer carbon electrodes give harder, longer-wearing surfaces

Among the money-saving applications of carbon arc welding is renewing the surfaces of steam shovel teeth, drag line buckets, crusher plates and other equipment parts subject to rapid wear.

The use of Speer Hold-Ark Electrodes further increases the efficiency and economy of such reclamation jobs through extra savings.

The uniform composition of Speer Electrodes provides even, steady burning, with maximum heat and penetration at welding point. High current carrying capacity, plus exceptional stability, mean less spluttering and spindling waste . . . 13% more welds per inch of rod.

This smooth burning develops a better point, as well, concentrating the arc for hotter, more uniform welds.

Investigate these benefits yourself. For a demonstration of greater speed, quality and economy for all types of carbon arc welding and cutting, send for a trial lot of Speer Carbon Electrodes today.

Speer

CARBON COMPANY
ST. MARYS, PENNA.

brushes · contacts · rheostat discs · packing rings · carbon parts

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3239

One of a series *of messages to help you increase your understanding of business paper advertising, and its effect on your business.*

Why you and your advertising manager are partners

FROM WHERE YOU SIT, advertising may look like the "glamour department" of your company—necessary, of course, but pretty far removed from the hard-headed realities of the production line.

But take a closer look. In one respect, the advertising manager's job bears a striking resemblance to your own.

You're production-minded. You're concerned with anything that will improve plant procedures, speed up assembly time, prevent waste, and reduce the manufacturing cost per unit.

And that is precisely where you walk arm-in-arm with your advertising manager. Because he thinks the same way about the *manufacture of a sale.*

The whole process of selling and distribution are his assembly line. And every time he can reduce the unit cost of a sale by so much as a few cents, he increases your company's chance to show a profit.

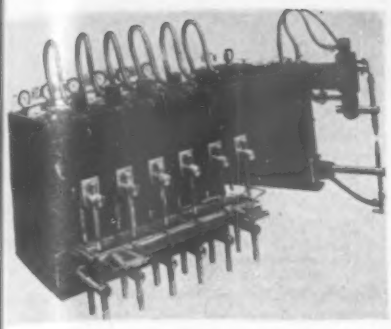
Ask him for a definition of advertising, and he will probably tell you that it is simply *mechanized selling,* a machine that multiplies the productive capacity of the sales force — seeking out prospects, arousing their interest, creating a preference for the things your company makes.

And when it is concentrated among the hand-picked readers of business papers, advertising becomes the most efficient machine this partner of yours has found for lowering the cost of producing a sale.

What are the ten ways to measure the results of your business paper advertising? You'll find the answers in a recent ABP folder, which we'll be glad to send you on request. Also, if you'd like reprints of this advertisement (or the entire series) to show to others in your organization, you may have them for the asking.

WELDING ENGINEER

is one of the 129 members of The Associated Business Papers, whose chief purpose is to maintain the highest standards of editorial helpfulness—for the benefit of reader and advertiser alike.



Spot welder for joining up to 12 gauge steel

Automatic Spot Welder

A NEW general-purpose bench-mounted spot welder incorporates controlled air-operated electrode pressure, adjustable current setting, electronic timing and automatic pressure-initiation of current. The welding current is automatically applied after the electrode pressure has reached a predetermined pressure setting, adjustable from 0 to 90 psi. Current duration may be varied from 1/30 to 2 seconds, and a four-position head control switch provides amperage adjustment for light or heavy work.

Transformer is rated nominally at 8 kva and operates from 220 volts, 60 cycle, although it can be supplied for 440 volts. Each welder is 4 in. wide, 32 in. deep, 24 in. high and has a 12-in. throat depth. Multiple production may be achieved by gauging several units; when operation is multiple, all can be initiated by a common air valve. METRON INSTRUMENT Co., 432 Lincoln St., Denver 9, Colo.

☆ ☆

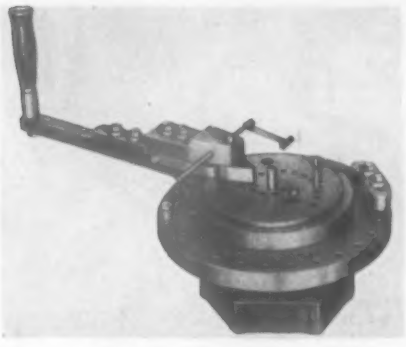
Low temperature welding flux for cast iron, steel, etc. Preheating is often eliminated

Welding Flux

CATALYTIC action that makes possible a weld at lower temperature is one of the claims of a new welding flux, "Thermo-Lo Blue." In many cases, states manufacturer, this flux will save preheating. The flux is dehydrated in manufacture and ground as fine as face powder. It is recommended for welding cast iron, steel and other ferrous materials. FARRELLOY Co., 1243 No. 26th St., Philadelphia 21.

Duplicating Bender

ALL types of ductile materials such as round, half-round, hexagon, square rod, tubing, angle, channel molding, strip stock and bus bar can be contour formed with the new "Di-Acro Bener 1-A." This multi-purpose bending machine will form and duplicate a wide variety of parts on a production basis. An automatic forming nose opens rapidly to receive and deliver



Di-Acro bender No. 1-A has a radius capacity of 0 to 6 in.

materials; an eccentric holding pin locks the material during the forming operation, and an adjustable stop determines to die tolerance the degree of radius forming. O'NEIL-IRWIN MFG. Co., 385-8th Ave., Lake City, Minn.

☆ ☆

Fume Exhauster

A NEW portable welding fume exhauster is recommended for use where stationary ventilating systems are unavailable or impracticable. It is especially suited for operations in cramped, confined quarters or where the weldor must move from place to place in enclosed areas. Harmful fumes are removed and a clean, safe atmosphere provided.

The unit weighs 25 lbs., is 34 in. long and 10 in. in diameter. It is completely self-contained and if necessary, may be held in one hand while the weldor works with the other. Filter tubes can be surged of accumulated particles by pulling several times on a cord extending to the outside of the unit. MINE SAFETY APPLIANCES Co., Braddock, Thomas & Meade Sts., Pittsburgh 8.

☆ ☆

Aluminum Sheet

A NEW aluminum-sheet material may be used for ducts in heating, ventilating and air conditioning systems and has many other uses in building. Its light weight gives the user three times as many square feet per pound as compared to conventional materials. This utility sheet is easily welded, bent, formed and otherwise fabricated. It is available as a roller-leveled flat sheet in widths of 30, 32, 36 and 48 in. and lengths of 96, 120 and 144 in.; coiled sheet is available in widths of 24, 30, 32, 36 and 48 in. Thicknesses range from 0.018 to 0.064 in. REYNOLDS METAL Co., 2500 So. Third St., Louisville, Ky.

Nageldinger Style "N" 608 Regulator for delivery of pressures up to 500 lbs. p.s.i.

We Manufacture Oxygen Therapy Apparatus • Cylinder Valves • Cylinder Manifolds • Needle Valve Controls • Welding and Cutting Equipment • Pressure Regulating Valves & Regulators • Safety Valves • Compressed Gas Apparatus for: Oxygen, Hydrogen, Nitrogen, Acetylene, Carbon-Dioxide, Helium, Etc.

Send for 32-Page Catalog Featuring Welding and Cutting Equipment and Supplies.

JOHN NAGELDINGER & SON
Incorporated
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welding champs use Callite

PURETUNG
99% PURE TUNGSTEN WELDING ELECTRODES

electrodes for atomic hydrogen, helium and argon arc welding

Because . . .

1. welds are extremely ductile, uniform, sound and smooth.
2. Puretung rods retain their rigidity and thereby speed welding.
3. Puretung rods are consumed slowly and appreciably reduce "down" time.
4. resultant welds require a minimum of grinding and finishing, hence, cut overall costs.

Send today for Bulletin #154. Our engineers will be glad to discuss Puretung with you. Callite Tungsten Corporation, 549 Thirty-ninth St., Union City, N. J. Branch offices: Chicago and Cleveland.

CALLITE TUNGSTEN CORPORATION CT

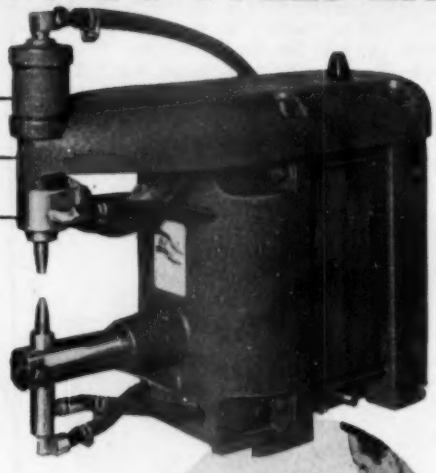
Callite

Standard or special-polished, clean and black. 7 standard dia.; 12" lengths; random lengths and other dia. on order

SPECIALISTS IN THE FIELD OF TUNGSTEN METALLURGY FOR OVER 35 YEARS

Banner 3 KVA SPOT WELDER

Economical!
Versatile!
Flexible!



The Banner 3KVA answers your need for a low cost, versatile air-operated Spot Welder that's adaptable to many uses. It operates with equal ease in any position — is quickly adjusted to new applications — and, being basically simple in design — requires but a minimum of maintenance.

These features add up quickly in production savings and increased efficiency when you use several 3KVA welders in a series working off a single timer and foot switch. For, you eliminate the high initial investment, costly maintenance and the expense of scrapping obsolete units—usually found in large multi-gun installations.

"We eliminated all rejects and returns when we changed to Banner 3KVA'S —from multigun operation," reports MakeAll Tool & Die, Milwaukee — manufacturers of Bod Kin steel arrow tips for deer hunters.

BP Co

BANNER PRODUCTS COMPANY
4936 NORTH 29TH STREET • MILWAUKEE 9, WISCONSIN

Now—a real heavy duty JUMBO CLAMP

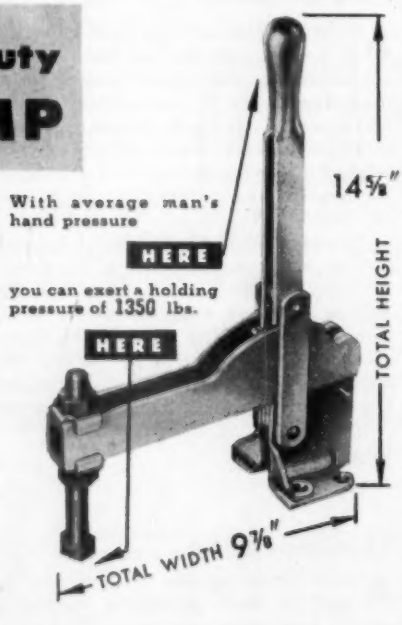
It is the only big clamp we know of that provides for spindle adjustment along the toggle bar.

It has a special designed base having an ingenious, integral front corner and back support, making deflection at spindle only 5/32".

Each clamp comes equipped with an adjustable spindle assembly. However, this can be removed and a special pressure pad to suit your requirements can easily be substituted.

The clamp, catalogued as V-1100, has comfortable hand grip. Weighs 6 lbs.

The maximum recommended pressure is 1350 lbs.



As exclusive manufacturers of clamping devices, we do encounter a wide variety of clamping problems. You will find it very advantageous to draw on this extensive experience. Write for catalog showing full Knu-Vise line of clamping devices.

LAPEER MANUFACTURINC COMPANY
General Sales Office
2906 W. GRAND BOULEVARD
DETROIT 2, MICHIGAN

Brazing kit for light bench work up to ¼ in.

Brazing Kit

A NEW silver-brazing kit, includes a tube of flux paste, an alcohol torch, a supply of fuel and 100 in. of brazing wire in assorted sizes and 1-in. wide strip sheets. Material up to ¼-in. thickness may be silver brazed with this outfit, states manufacturer. The kit is also sold without the alcohol torch, permitting an oxy-acetylene torch to be used instead. AMERICAN PRODUCTS CORP., 804-6 Lowell Bldg., Chicago 5.

☆ ☆

Air nozzle with various types of noses

Air Nozzle

A NEW, heavy-duty air nozzle has a body made from a heat-treated duraluminum forging and is available with four noses: (1) a general purpose nose; (2) a long nose which can be bent for getting into recesses, pockets, etc.; (3) an adjustable nose for high-pressure lines or where air blast must be controlled; and (4) a wide, flat nose for broad surfaces. Nozzle has a pistol grip to fit the hand and a neoprine washer to withstand oils and acids in air. THE IMPERIAL BRASS MFG. CO., 1200 W. Harrison St., Chicago 7.

☆ ☆

Multi-Head Spot Welder

To help adopt Quonset huts to civilian needs, SCIAKY BROS., INC., 4911 W. 67th St., Chicago 38, has developed a multiple-head spot welder that comprises 16 hydraulic cylinders and eight welding transformers. It is capable of welding 88 spots to form large curved joists of the Quonsets at a production rate under ideal conditions of one complete joist per minute. It is rated at a peak of 1,000 kva and is capable of handling up to 11-gauge steel. The machine is subdivided into 11 units, each a complete welder in itself. The cylinders are provided with automatic adjustment to compensate for wear on electrode tips.

About People

DONALD A. KEATING has been placed in charge of the technical department for the mid-western division of Turco Products, Inc. He will direct technical activities of the organization in the twelve mid-western states from his headquarters in Chicago. James D. Schwedler has been appointed to take charge of the technical activities for the company's southwestern division. With headquarters in Houston, he will direct all technical service activities of the organization in the southwestern states, specializing in industrial cleaning and maintenance problems such as corrosion removal for the metal working industry.

☆ ☆

SIGMUND W. STEWART, formerly assistant purchasing agent of the Continental Electric Co., Inc., has been appointed general purchasing agent for the Vanadium Corp. of America, with headquarters at Niagara Falls, N. Y. He is assisted by J. M. MENK, formerly works accountant for the firm. GEORGE W. JOHNSON has been named manager of the company's steel foundry division, with headquarters in Chicago.

☆ ☆

PROFESSOR R. S. GREEN of the department of industrial engineering of Ohio State University has been appointed Editor-in-Chief of the James F. Lincoln Arc Welding Foundation's new book "Design for Welding." Professor Green is in charge of the University's 5 year course in welding engineering which is the only course of its kind in this country leading to a graduate degree.

☆ ☆

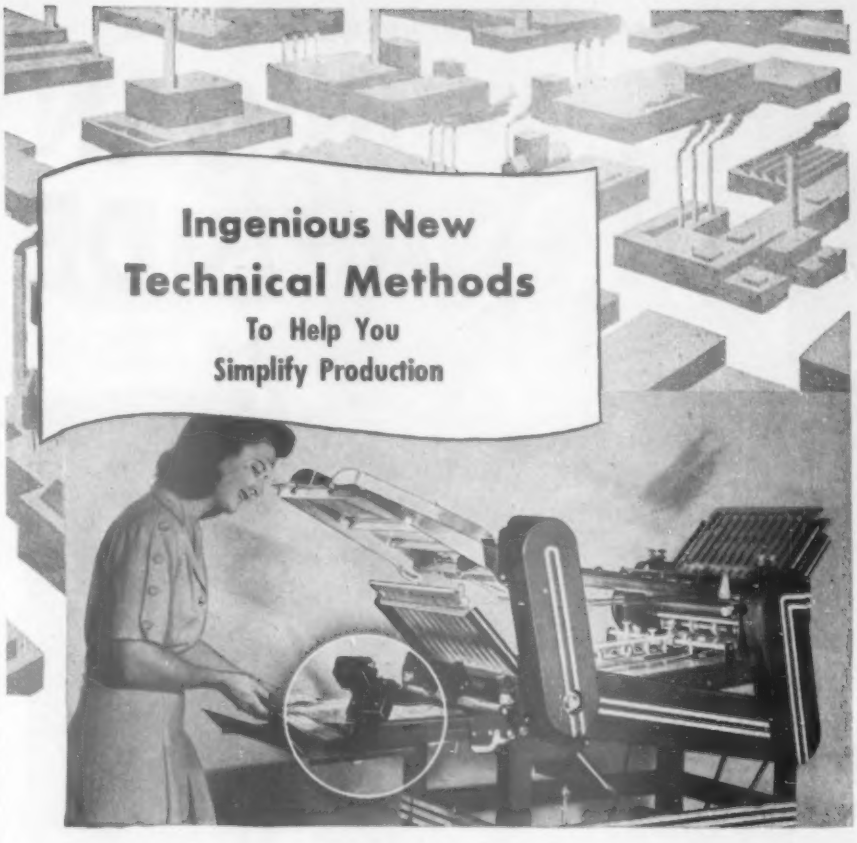
C. H. LINDER has been appointed assistant manager of manufacturing for General Electric Company's apparatus department. ADDISON E. WILES has been named manager of the company's Pittsfield molded products works. He succeeds ARTHUR C. Treece, who is now assistant manager of the new plastics laminating plant at Coshocton, O.

☆ ☆

PAUL S. PARK has been named manager of the engineering service department of A. M. Byers Co., Pittsburgh. Mr. Park's department has been instrumental in the development of radiant heating and snow melting systems which employ the use of welded wrought iron pipe.

☆ ☆

L. A. WELCH has been appointed executive vice-president for R. G. LeTourneau, Inc., Peoria. He will assist in coördinating the functions of the division managers at company factories in Longview, Tex.; Toccoa, Ga.; and Vicksburg, Miss.



Instantaneous Production Control With Improved Electric Counter

Accurate, up-to-the-minute counting of the production on this Davidson Folding Machine is done with the WIZARD Electric Counter.

The Wizard Electric Counter

New opportunities for more efficient production and elimination of over-run waste are created by WIZARD Electric Counters. These electrically-operated devices count any object or motion that will operate a switch, relay or photo-electric unit. Objects can be counted photo-electrically without physical contact and without risk to fragile or freshly-painted objects.

The Counters can be installed at any distance from the switch or photo-electric unit where the count originates. Or, they can be mounted on panels in the Production Department and arranged so that a production supervisor can maintain up-to-the-instant counts of all operations throughout the entire plant.

You can also count on chewing gum to help employee's on-the-job efficiency. Chewing gum helps relieve tension—keeps the throat moist—and prevents "false thirst" yet leaves hands free for work. That's why more and more plant owners are making Wrigley's Spearmint Gum available to everyone.

Complete details may be obtained from Production Instrument Company, 710 West Jackson Boulevard, Chicago 6, Illinois.

AB-80

Master Hands on Intricate Jobs use

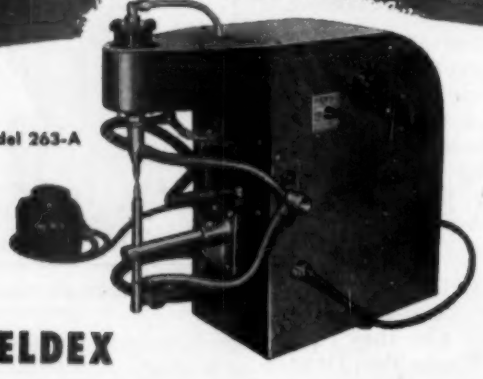
SHAWINIGAN CARBIDE

SHAWINIGAN

SHAWINIGAN PRODUCTS CORPORATION

EMPIRE STATE BUILDING,
NEW YORK 1, N.Y.

PRODUCTION BOOSTER



Model 263-A

WELDEX

Automatic **Bench-Type Spotwelder**

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- **263-A Air operated (Bench Style) 3 KVA**
- **273-R, 273-P, 273-RS Manually operated (Floor Style) 7½ KVA**
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MANUFACTURERS

Investigate this NEW METHOD of light metal fabrication. Ask for bulletins and folder showing accomplishments with Weldex Welders.

DR. W. A. PENNINGTON, chief chemist and metallurgist of the Carrier Corp., Syracuse, N. Y., recently received the Henry Marion Howe Medal for 1947 for his paper, "A Mechanism of the Surface Decarburization of Steel." The award was made by the American Society for Metals at its annual banquet during the National Metal Congress and Exposition.

☆ ☆

MAX HANSEN, distinguished German scientist of non-ferrous metallurgy, has been appointed associate professor of metallurgical engineering at Illinois Institute of Technology. Professor Hansen recently made a compilation of German scientific progress during the war for the technical field information agency of the United States Office of Military Government in Germany.

☆ ☆

G. EDWARD CONN, JR., has been named manager of the newly established Allis-Chalmers Manufacturing Company's branch office at York, Pa. MACGREIGER C. JONES, formerly resident representative at the Harrisburg branch, which has been discontinued, will assist Mr. Conn as sales representative.

☆ ☆

R. H. NEWTON has been appointed to the newly created office of manager of dealer sales for the Lincoln Electric Co., Cleveland. Mr. Newton's duties will be to develop an organization to sell and serve this mass market.

☆ ☆

EDWARD HANLEY, vice-president of finances, secretary and treasurer of Allegheny Ludlum Steel Corp., has been elected a director of the company. STANLEY A. MCCASKEY has been elected secretary to relieve Mr. Hanley of that duty.

☆ ☆

Recent appointments in the personnel department of Air Reduction Sales Co. include: HAROLD H. REED as New York district manager; OREN M. DONOHUE as assistant to Mr. Reed; WILLIAM B. BROWER as assistant sales manager.

☆ ☆

FREDERICK H. FOGLESONG, formerly with the Steel & Tube Division of the Timken Roller Bearing Co., Detroit, has joined the Detroit district sales office of the Babcock & Wilcox Tube Co.

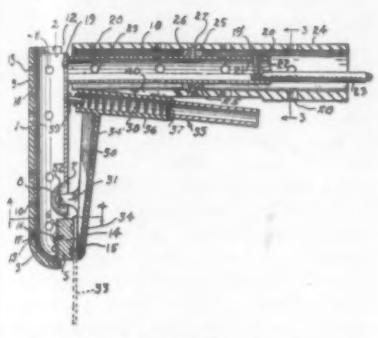
☆ ☆

LANCE H. COPPER, of London, England, a member of the staff of the Mond Nickel Co. and one of its delegate directors since 1945, has been elected assistant secretary and assistant treasurer of the International Nickel Co., Canada, Ltd.

☆ ☆

CHARLES J. KOLB, formerly director of industrial relations for Colonial Radio Corp., has joined Niagara Machine & Tool Works, Buffalo, N. Y., in the same capacity.

From the Patent Office



Electrode Holder

2,428,065. WILLIAM T. COCKRILL and THOMAS J. DUNCAN, Flint, Mich. Filed Nov. 14, 1945. Issued Sept. 30, 1947.

In this holder, a tubular jaw-carrying member has a butt end and a substantially closed front end provided with a side socket. A tubular shank member extends from the butt end at a right angle, and a block-like jaw member is fixed in the socket. A bar having a front jaw-forming end is pivoted on the jaw-carrying member for rocking in opposite directions to move the jaw-forming end into and from clamping relation to the jaw member. A handle-forming sheath of insulation surrounds the shank. A tubular hand-grip lever of insulation extends across the rear end of the bar alongside the handle-forming sheath and is operable by a hand grasping the sheath to rock the bar in a direction to move the jaw-forming end of the bar out of clamping relation. A coil spring in the hand lever bears against the jaw-carrying member and tensions the hand-grip lever against operation in that direction.

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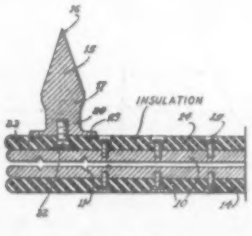

Holder and Chipping Tool

2,428,138. JOHN H. BLAKEMORE, Chicago, Ill. Filed Nov. 9, 1944. Issued Sept. 30, 1947.

The combination with an electrode holder of a chipping hammer, secured to the holder in electrically insulated relation. The securing means for the chipping tool is designed to facilitate the setting of the tool with the working edge at any desired angle.

Without a Dependable MIXER You Haven't Got a GOOD TORCH!

When a torch has a mixer that will function with dependable efficiency, using tip sizes 00 to 12 inclusive . . . compensating for both welding gas pressures and welding tip sizes—and one that will produce a *longer, hotter* flame, using the same gas pressures, you may be sure that *that* torch is trade-marked MECO.

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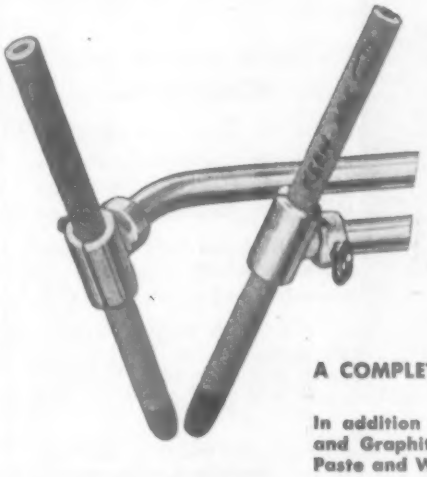

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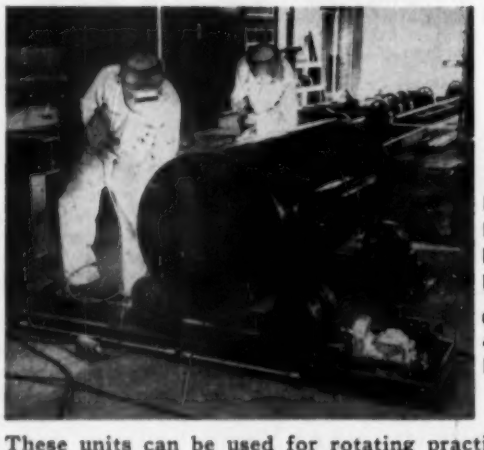

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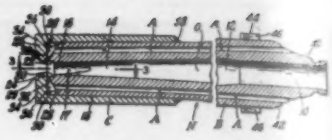

Torch Tip

2,425,710. JAMES H. BUCKNAM, Cranford, and IVAN P. THOMPSON, Elizabeth, N. J., assigned to THE LINDE AIR PRODUCTS Co., New York City. Filed Nov. 1, 1944. Issued Aug. 19, 1947.

A post-mixed desurfacing tip having a single oblong discharge orifice for discharging a stream of oxygen and an oxygen-supply passage upstream of and axially in line with the orifice. Supply passage has an outlet portion upstream of the orifice which gradually changes from circular to oblong cross-section. Each longer side of the passage is provided with a lateral step portion for creating an eddy current fringe of oxygen downstream of the orifice. Step portions form an enlarged passage, terminating in a second discharge orifice. Enlarged fuel gas chambers are formed adjacent opposite longer sides of the enlarged passage, and fuel gas supply passages discharge into the chambers. A restricted passage provides communication between the chambers and enlarged portion.

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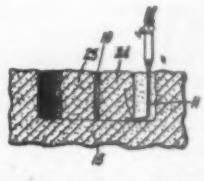

Rock-Cutting Method

2,426,688. BRYANT H. HIGGS, Salt Lake City, Utah, assigned to THE LINDE AIR PRODUCTS Co., New York City. Filed Nov. 30, 1943. Issued Sept. 2, 1947.

A method of forming a cavity in a body of mineral material by means of an oxy-acetylene torch. Steps are: to form at least one groove in the portion to be removed by applying along a selected path localized heat of sufficient intensity to remove the material; undercutting the portion by applying localized heat, starting from the bottom of the groove; removing the undercut portion.

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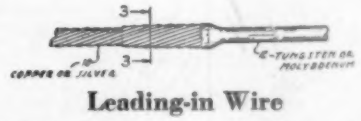

Leading-in Wire

2,427,727. CHARLES N. HUNTLEY, University Heights, and JOHN A. CAMPBELL, Willoughby, O., assigned to GENERAL ELECTRIC Co., New York City. Filed Sept. 24, 1943. Issued Sept. 23, 1947.

A lead-in wire comprising a flexible stranded conductor of copper or silver and a solid conductor of tungsten or molybdenum. The plated end of the stranded conductor is butt welded to an end of the solid conductor with a quantity of nickel metal fused to and around the adjacent ends of both conductors.

Welding Vanes to Turbine Rotors

2,426,746. NATHAN C. PRICE, Hollywood, and HAROLD A. GREENWALD, West Los Angeles, Calif., assigned to LOCKHEED AIRCRAFT CORP., Burbank, Calif. Filed March 20, 1944, and June 22, 1945. Issued Sept. 2, 1947.

Apparatus for welding vanes to turbine rotors, comprising in combination, means for rotatably supporting a rotor drum, adjustable means for fixing drum in predetermined angular positions, means associated with supporting means for retaining an impeller blade, cylinder and piston means for moving retaining means and impeller blade radially so that an impeller blade root may be pressed in forceful contact with the rotor drum, means to pass welding current between the supporting and impeller blade retaining means.

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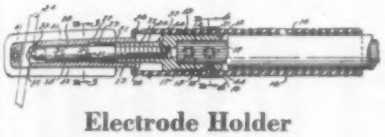


Electrode Holder

2,427,894. CHARLES E. BENNER, Grosse Pointe Woods, Mich., assigned to MOTT STEEL PRODUCTS CO., Detroit. Filed April 28, 1945. Issued Sept. 23, 1947.

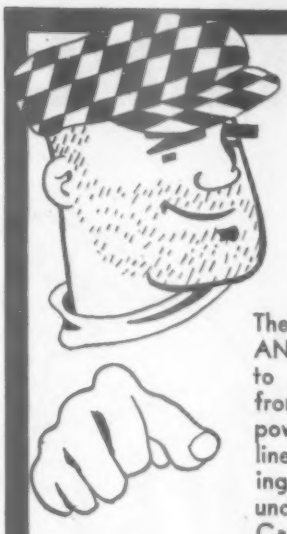
An electrode holder embodying a tubular handle, a cable terminal within the handle, a screw extending through the wall of the handle into the terminal, a resilient band threaded for insulating the screw head, a forwardly projecting tubular extension on its interior and exterior surface, a rod threaded within the tubular extension and a cap threaded onto the threads of the outer surface of the extension containing a hollow interior into which the rod extends. The cap has sides which converge from the threaded to the opposite ends.

☆ ☆

Industrial Eyeshield

2,427,918. ROBERT L. MALOOM and WILLIS Z. WHIPPLE, Chicago, Ill., assigned to CHICAGO EYE SHIELD CO. Filed July 3, 1943. Issued Sept. 23, 1947.

A rigid frame to protect and hold the lenses of an industrial eyeshield. Frame comprises a frontal section having cutout areas with marginal portions around the cutout sections bent backwardly and normal to the frontal section. These terminate in ledges against which to seat lenses from the front of the frame. The backwardly bent portions have apertures therein. Resilient lenses seated against the ledges are disposed inwardly of the front plane of frame. Extensions on the lenses project into the apertures interlockingly to hold lenses in position.



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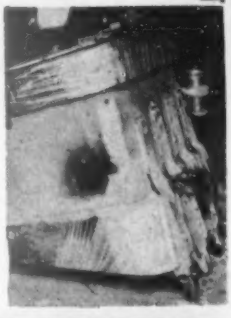

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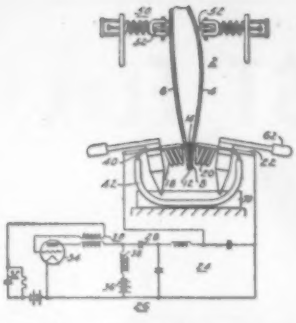

Induction Brazing Apparatus

2,427,747. Stanley S. Schneider, Lansdowne, and Warren D. Kinsman, Catonsville, Md., assigned to Westinghouse Electric Corp., East Pittsburgh, Pa. Filed July 7, 1944. Issued Sept. 23, 1947.

Brazing apparatus for brazing a fillet in the edge between two spaced sloping walls of a hollow, narrow elongated object. A pair of coreless induction heating coils having facing, upstanding ends are spaced from each other to provide a path between them through which the edge of the workpiece may pass. Coils are so wound and connected as to cause the fields at facing ends to be of the same magnetic polarity at substantially any instant. High-frequency energizing of the coils produces heat for melting brazing compounds inside the sloping walls of the workpiece, along the edge. A guiding means including a roller positions the edge-portions of the walls during movement of the workpiece between coils so that the extreme tip of the latter is beyond the coil ends and is heated less than the brazing compound. A predetermined distance is maintained between each coil and the proximate wall of the object.

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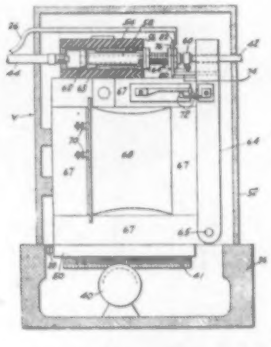

Arc-Cutting Method

2,427,588. Henry J. Burnett, East Hartford, Conn., assigned to United Aircraft Corp., East Hartford, Conn. Filed October 17, 1942. Issued Sept. 16, 1947.

In apparatus for forming precision holes in hardened metal, means for applying an electric potential across an electrode and the workpiece for establishing an electric arc and means for vibrating the electrode in the direction of its length for rapidly interrupting the arc. Means for changing the period of vibration of the electrode, and means for directing a cooling fluid onto the seat of the arc for vacating the metal liberated by the arc are also included.

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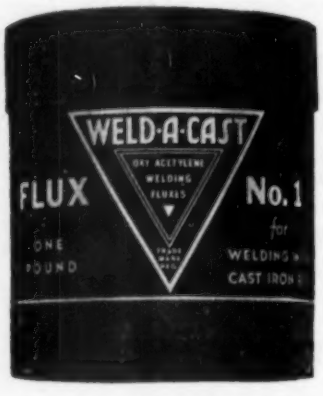

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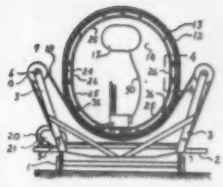
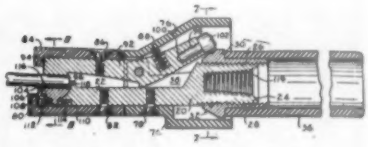


Seam-Welding Equipment

2,428,161. ALBERT ERNEST HOUSE, West Vancouver, British Columbia, Canada. Filed Aug. 28, 1945. Issued Sept. 30, 1947.

Welding equipment for the welding of an inside girth seam in a hollow body. It comprises a support for the body, means for moving the body in the direction of the seam and a track conforming to the inner contour of the seam to support a welding head inside the body. The track is secured to the inner periphery of the body adjacent the seam.

☆ ☆



Electrode Holder

2,427,002. PERCY JEPSON, Oakland, Calif. Filed March 3, 1945. Issued Sept. 9, 1947.

An electrode holder comprising a body of material having a means engageable by one extremity of an electrode. The engaging means includes a member movable with the electrode to dispose the latter at a predetermined angle relative to the body and a positive stop means associated with the member to contact the end face of the electrode and prevent endwise movement in one direction. A manually adjustable means mounted on the body to engage the electrode and rigidly secure the movable member and the electrode against movement relative to each other and to the body, in response to forces incidental to application of the electrode to the work.

☆ ☆

Chemical Production of Oxygen

2,427,709. EUGENE O. BRIMM, Kenmore, N. Y., assigned to LINDE AIR PRODUCTS CO., New York City. Filed July 3, 1942. Issued Sept. 23, 1947.

A process for extracting oxygen from a mixture of oxygen with inert gas. Alternate streams of the mixture and steam are passed over a hot solid contact mass characterized by its ability to be deoxidized and oxidized alternately by steam and oxygen. This mass is a sintered material comprising complexes of manganese, oxygen, molybdenum, and an alkali metal, having a composition and relationship of elements such as theoretically to form a double manganate-molybdate salt. The alkali metal is in excess of the amount required in said double salt by an amount just sufficient to combine with the other uncombined acidic materials in the mass.

Christmas Greetings

THE year just closing has to a marked degree been one of plans and purposes and it is fitting that we express to you our genuine and wholehearted appreciation for your patient and unselfish support and co-operation in our efforts.

The future will be crystallized in new dimensions of progress everywhere and we look forward with undaunted hope and confidence to a New Year of unprecedented opportunities for all.

For your patience and understanding on those occasions when deliveries were slow because of circumstances beyond our control, we are deeply grateful. We shall endeavor in every possible way to merit your continued confidence and patronage.

In that spirit we extend to you and yours our best wishes for a happy holiday season.

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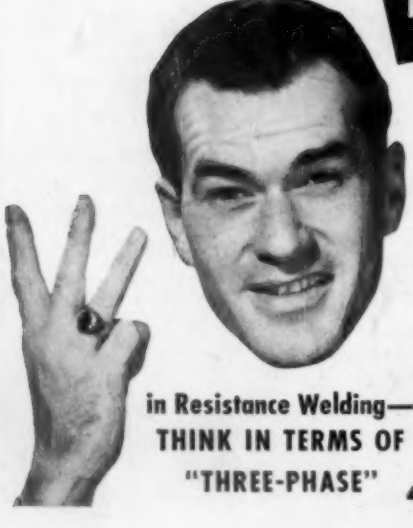

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THE CLOSED SHOP

Key to Labor Monopoly

IF THE PEOPLE of the United States are to loosen the monopoly control now exercised by some segments of union labor and recapture the power to control their own economic and political destiny, they must come to grips with the problem of the closed shop. A satisfactory solution of that problem is as vital to the interests of the wage earner, who should be fully protected in his right to organize and bargain collectively through representatives of his own choosing, as it is vital to the interests of the nation as a whole.

By the closed shop, which unfortunately is a term that seems to shed more heat than light, I mean any shop in which the worker must make his peace with a union in order to have a job. There are approximately 13½ million union members in the United States. Of these about 10 million are governed by arrangements calling for "closed" shops, union shops, maintenance of membership provisions and similar devices which make good standing in a union a condition to holding a job.

Such arrangements raise serious issues about what is commonly presumed to be the basic American right to work. Also, closed shop arrangements lie at the root of the dominant economic power now exercised by some labor leaders.

The problem of reducing the power of these labor leaders to proportions that make it safe for democracy is the age-old problem of monopoly. In an earlier era this problem was created largely by businessmen who sought to escape the restraints of competition by combinations or agreements to control prices and production. Such efforts are still attempted and must be curbed by law.

Union Labor Monopoly

But, after more than a decade during which a monopoly position for organized labor has been aggressively promoted by the federal government, the major monopolists today are those labor leaders who wield the power of enormous nationwide unions. About 90% of the soft coal miners do the bidding of John L. Lewis. A like percentage of the auto workers are represented by the United Automobile Workers of the C. I. O. About 80% of the production workers in steel are members of the United Steel Workers, C. I. O. No single corporation has more than a fraction of the economic power that is concentrated in these unions. And if corporations were to combine their power to cope effectively with that of these union monopolies they would unquestionably find themselves charged with violating the federal antitrust laws.

In its national sweep, the monopoly power of unions rests largely on their exemption from the federal antitrust laws. My previous editorial in this series (the 53rd) discussed the desirability of removing that exemption. The local roots of this monopoly power are often embedded in closed shop arrangements.

Closed Shop in Coal

An illuminating case in point is provided by the United Mine Workers, whose leader John L. Lewis has graciously given the country a 3½-month reprieve from "the hysteria and frenzy of an economic crisis," as he himself termed it. During that latest crisis the dispatches from the soft coal fields reported that the miners were standing behind John L. Lewis almost to a man. And the implication usually was that the driving forces of the strike were loyalty to Lewis and the prospect of economic gain.

Underlying that performance, however, and basic to it was an agreement in the soft coal fields providing that "as a condition of employment all employees shall be members of the United Mine Workers." Hence to hold a job in 90% of the soft coal industry which is governed by contracts with the United Mine Workers, a miner must not offend the union. To avoid offense the union member must even be careful in criticising what his union

does. *Suspension from the union for six months, and hence from the right to hold a job,* is the penalty imposed by the United Mine Workers constitution for circulating a statement "wrongfully condemning any decision rendered by any officer of the organization."

The willingness of the miners to follow Lewis until the country froze over was not, of course, exclusively a product of the agreement limiting jobs in the coal fields to union members of good standing. Some of it originated in bad handling of employee relations in the coal fields in years gone by. But the fact remains that Lewis' soft coal monopoly has as one of its principal foundations an agreement which gives the United Mine Workers a job-or-no-job hold on 90% of the soft coal miners.

In its extreme form, the closed shop not only makes union membership a condition of employment but narrowly limits the numbers admitted to union membership and hence to the opportunity to work. In this way it is used to enforce restriction of output and working rules which would never stand up under free competition.

Fair Dealing

The closed shop raises major issues of personal freedom and fair dealing between individuals. As matters now stand, closed shop agreements require employers to discharge workers who lose their good standing in the unions involved. At the same time they frequently impose no requirement on unions to grant membership to law abiding and technically qualified persons. Many unions with closed shop agreements refuse to grant membership on the basis of competence. Thus, qualified workers are denied a fair chance to hold a job.

In its dealings with the closed shop issue the federal government has been pushed into a self-contradictory position. The National Labor Relations Act (the Wagner Act) provides, and properly, that "employees shall have the right . . . to bargain collectively through representatives of their own choosing." In furtherance of that basic proposition, the Wagner Act also provides that "It shall be an unfair labor practice for an employer . . . by discrimination in regard to hire or tenure of employment to encourage or discourage membership in any labor organization . . ." Standing alone, the provision would clearly outlaw the closed shop.

But then, to favor the closed shop, the Wagner Act turns right around and provides that "nothing in this Act . . . shall preclude an employer from making an agreement with a labor organization . . . to require, as a condition of employment, membership therein," provided that certain conditions of representation are fulfilled. This places the National Labor Relations Board in the impossible position of trying to administer a law which simultaneously points in opposite directions.

In successfully contending that there should be no closed shop arrangements on the railroads, the late Joseph Eastman, Federal Co-ordinator of Transportation, said, "If genuine freedom of choice is to be the basis of labor relations under the Railway Labor Act, as it should be, then the yellow dog contract and his corollary, the closed shop . . . have no place in the picture." The so-called yellow dog contract, which requires a worker to agree not to join a union as a condition of employment, has long since been outlawed.

At one time the closed shop was defended as a protective device for feeble young unions struggling against predatory employers. But a mere glance over the current economic scene discloses that the time when that argument was supported by the facts is past. Now it is the labor leaders who frequently exercise decisive economic power.

At elections in November three more states, Arizona, Nebraska and South Dakota, passed constitutional amendments outlawing the closed shop. In doing so, they joined six other states, which, in one way or another, have restricted the closed shop. The South Dakota amendment presented the basic issue created by the closed shop in simple and direct terms when it declared that "The right of persons to work shall not be denied or abridged on account of membership or non-membership in any labor union, or labor organization."

That issue must be squarely faced by the new Congress if its first order of business, the labor crisis, is to be resolved.

President McGraw-Hill Publishing Company, Inc.

INDUSTRY-WIDE BARGAINING...

Death Trap for Business, Suicide for Free Labor

IF CONGRESS is to succeed in its present efforts to prevent strikes in key industries from devastating the nation, it will have to put a crimp in industry-wide collective bargaining. This kind of bargaining is designed to apply agreements between employers and organized workers on wages and working conditions to an entire industry.

Further, if extension of this type of bargaining is not curbed, there is reason to believe that it will undermine the freedom of both American business enterprise and American wage earners. For, while increasing the destructive power of labor disputes, the general spread of industry-wide bargaining would so concentrate the fixing of wages—by far the largest element in the cost of production—that government regulation would be a next short step. With that step taken, freedom for business enterprise and freedom for labor would be well on the way out.

Unfortunately, industry-wide bargaining is commonly regarded as presenting a general conflict between organized labor and employers, with unions favoring it and employers opposed to it. This mistaken notion raises the heat of much of the discussion without increasing the light. The fact is there is no such general conflict. Employers and organized workers are on both sides of the argument about industry-wide collective bargaining. For example, while some union leaders are characterizing as labor baiters all those who raise the slightest question as to the desirability of industry-wide bargaining, organized workers in the air transport industry are strenuously opposing that type of bargaining; and the employers are advocating it.

Some Employers Like It

The reason there is in fact no clear cut issue between employers and unions over industry-wide bargaining is readily understandable. It presents certain advantages to both sides in the bargaining process. For example, union advocates of such bargaining generally stress the fact that industry-wide agreement on wages protects wage standards from being undercut by lower wage areas and lower wage employers. By much the same token, however, employers who like it often emphasize the fact that industry-wide bargaining may save certain well-managed and prosperous companies from being singled out for particularly heavy wage exactions. This general point has been underlined in both the full-fashioned hosiery industry and the West Coast paper and pulp industry. There, local unions, affiliated with international unions, have protested that industry-wide collective bargaining prevents them from getting from especially prosperous employers wages as high as they could get if allowed to go it alone in collective bargaining.

So long as employers remain subject to the federal antitrust laws while unions are exempted, the balance of power in industry-wide bargaining would seem to be heavily weighted on the side of the unions. If, for example, employers were to announce an intention to match an industry-wide wage increase by an industry-wide price increase, there is no doubt that they would promptly be indicted for violation of the federal antitrust laws. Even so, the fact remains that some employers favor industry-wide bargaining while some segments of organized labor are against it.

A Clear Cut Public Issue

The industry-wide bargaining issue as it affects the public, however, is clear cut. It is concentration of economic power (in the hands of both unions and management) which can make industrial conflict devastating to the public welfare. At least five times within about a year—in steel, on the railroads, in the maritime industry and twice in the soft coal industry—strikes prompted by union efforts to impose industry-wide agreement about wages and working conditions have paralyzed large parts of the nation's economic life.

In soft coal about 90% of the production workers are members of the United Mine Workers. In steel

about 80% of the production workers are members of the United Steelworkers, C. I. O. In some other key industries there is a comparable degree of concentration of union control. In the face of such concentration many employers see no alternative but to get together on their side for industry-wide bargaining. But when they do so in key industries, the odds are lengthened that failure to agree on wages and related matters, will result in generally ruinous conflict. If agreement is reached, the chances are increased that it will take too little account of the welfare of the consuming public.

It is possible to have industry-wide bargaining on many subjects other than wages. *But the main interest is wages; and the main drive is toward industry-wide and ultimately nation-wide uniformity. Such uniformity is the deadly enemy of industrial decentralization and the pioneering expansion of industry in new areas.* Why pioneer, with inexperienced workers, if the wage rate must be uniform for the whole industry? Moreover, it would also be hard to conceive of a more effective way to put a blight on local efforts to improve industrial relations than to make wage rates and other working conditions uniform throughout the industry and then the nation. *However, among many other dangers, the overshadowing danger in industry-wide bargaining lies in its concentration of economic power.*

Wages Monopolized

On the average, the cost of labor accounts for about two-thirds of the total cost of all industrial products. The universal spread of industry-wide bargaining would thus concentrate in relatively few hands control of the greater part of the cost of industrial production. There is no reason to believe that even without disastrous strikes, such concentration would long continue free from government regulation. That would turn more earth for the graves of American business enterprise and American working men's freedom.

Those who believe that industry-wide bargaining serves the public well—and many sincere people do—stress the fact that, on the whole, it has worked in the industries where it has been tried over a considerable period. Most of the industries of which this is true, however, are not key industries. The pottery industry, the glassware industry, and the silk and rayon dyeing industry—to cite a few in which industry-wide bargaining has been practiced with considerable success—are important industries. But they are not industries in which strikes would have a ruinous impact on the nation. In contrast, a strike in the soft coal industry as the result of a breakdown of industry-wide negotiations quickly becomes a national disaster. The dangers inherent in industry-wide bargaining are multiplied accordingly.

England No Guide

Those who think extension of industry-wide bargaining would be good for the public often emphasize the fact that it has worked smoothly in England, where it has been extensively practiced. *Not the least of the things it has smoothed in England, however, is the transfer from private enterprise to state socialism of industries in which industry-wide bargaining by monopolistic unions and employer groups had so badly undercut competition that private enterprise had lost much of its justification.* A general extension of industry-wide bargaining could be expected to have the same consequences in this country.

The best way to curb industry-wide bargaining is a question which lies beyond this discussion. *Much would be accomplished if the federal government would discontinue its active promotion of industry-wide adjustments, in the fields of both labor and management, at which it has been busy ever since N. R. A. days. Still more would be accomplished if the federal antitrust laws were applied with even-handed justice both to unions and employers—a course urged in the 53rd editorial in this series.* Perhaps a definite limitation of the scope of labor agreements would also be necessary.

The effects of industry-wide bargaining in increasing the extent of public regulation of industry will vary. They will, of course, be less pronounced in railroads and other public utilities, which are already extensively regulated, than they will be elsewhere. For unregulated industries, however, industry-wide bargaining carries the threat of extensive regulation and, along the way, of industrial conflict devastating to the public. In these excited times, to say what I have said here is to invite characterization by overheated partizans as a foe of legitimate union progress. That is perhaps not so bad, however, as to qualify as a pall bearer for both American business enterprise and some of the basic freedoms of American working men. That may well be the fate of those who blindly accept the expansion of industry-wide collective bargaining as being "in tune with the times."

President McGraw-Hill Publishing Company, Inc.

TAX REVISION...

Can Make or Break American Business

IS THE American way of life—progress by private initiative—going to get a fair chance to demonstrate its superiority over all the challenging varieties of collectivism?

That's the real question before Congress as it confronts the long labor of remodeling the federal tax structure. What Congress does about taxes will come pretty close to making or breaking the U.S.A.

Today the tax colossus that sprawls across the national economy is unguided by any central nervous system. Its crushing weight comes down first here, then there, as the giant wobbles around, unguided by any central purpose except to grab as much as it can.

The central purpose of a tax system is simple. It should raise the necessary revenue without placing unnecessary fetters on enterprise.

As recently as 1929 federal taxes took only one dollar out of every twenty of national income. A loose-jointed and inconsistent tax structure was a nuisance then. But it wasn't serious.

Today the federal tax burden is the dominant element in the nation's economy.

Even if Congress succeeds in cutting $6 billions out of President Truman's $37.5 billion budget, federal taxes still will take about one dollar out of every five of the national income. And few Congressmen are hopeful enough to think that they can get the tax load below $25 billion for any year that is in sight.

Drastic Budget Cuts Required

Indeed, to get the tax load down to $25 billion, Congress will have to stop treating expenditures, like those for military purposes and veterans, as politically sacrosanct. Congress must scrutinize *every* item in the budget. Economy must go along with tax cutting or we shall end in bankruptcy.

Suppose that expenditures are slashed to the bone. Our taxes *still* will be so heavy that the *way* they are loaded on the nation's back will make a big difference in how well the nation gets along. That's something which the postwar boom has tended to obscure. It will become much clearer as this boom wears off. Then a remodeling of the federal tax system to remove its manifold obstructions to private enterprise will be of transcendent and obvious importance to everybody.

Tax Experts Agree

The remodeling will require political courage plus tax wisdom. Congress must supply its own political courage. But it can lean on tax experts for tax wisdom. Fortunately, tax experts now agree on the necessary reforms—especially on those that will remove obstructions to business. How well the tax experts agree is shown in the charts on the next page, summarizing answers to a questionnaire on possible federal tax reforms. The questions were asked by the Department of Economics of the McGraw-Hill Publishing Company. The answers came from a broad cross-section of tax experts, including the authors of a considerable crop of books on postwar federal taxes and what to do about them.

The experts agree (see the charts) that double taxation of corporate dividends should stop.

They agree that the tax rate on corporate income (now 38 percent) should be reduced as rapidly as possible to the initial rate on individual income (now 20 percent).

And they agree overwhelmingly that it is desirable to let net losses be subtracted from net profits over a 5-to-6-year period in computing business income for tax purposes.

All three changes would stimulate corporate initiative and hence make jobs. Averaging business incomes would make new ventures attractive even though these ventures *might* result in early losses. Reduction of the corporate income tax would have the same effect. So, too, would the elimination of that highly discriminatory provision whereby corporate dividends are taxed first as corporate profits, and again when received as income by individuals.

Penalties on Incentives

Beyond these changes, there must be an end to tax penalties on *individual* initiative. Consider the enterprising business man whose income fluctuates markedly from year to year. Because of his enterprise he may pay, on the same income, twice as much federal income tax as the man who plays it safe for a steady income. That's because he can't average his personal income over several years for tax purposes. He can count on heavy taxation of his good-year profits with no chance for offsetting against them his bad-year losses. It is a case of heads you lose, tails the tax collector wins. Eighty-six percent of the experts agree that an income-averaging allowance for individuals is desirable.

Three-quarters of them also agree that tax rates at the top end of the individual income scale (now running up almost to 90 percent) should come down. In my judgment, the total tax should not amount to more than 50 percent to encourage business men to venture for high stakes.

Advocating tax relief for men in the higher income brackets—and particularly for management men—has been considered political suicide for more than a decade. Some members of Congress still hold that view. A Democratic Congressman from Michigan told an Illinois colleague who advocated cutting upper bracket taxes, "If you put that idea forward at home, you won't come back."

The Congressman has an even better chance of not going back if our economy bogs down. One of the best ways to bog it down is to keep the taxes that destroy business incentives and block enterprise—for example, the confiscatory rates which drive the people in the high brackets away from risk-taking.

To give the American system of individual enterprise a fair chance was clearly the mandate of November's election. To give it that chance, enterprising business men must have a chance to make large rewards—as well as the always-present chance to lose their shirts. Under present tax rates, they don't get a break.

Prevailing federal taxation throttles bold business enterprise in other ways. It fails, for example, to encourage research and rapid industrial modernization. It tends to siphon investment away from private enterprise, driving it into tax exempt state and local securities. (The experts agree almost to a man that such tax exemption must be eliminated.) The list of obstacles could be amplified.

EXPERT OPINION ABOUT TAX REVISION

TAX EXPERTS THINK WE SHOULD:	% Of Tax Experts Favoring the Proposed Changes
1 ***Eliminate double taxation of corporation dividends*** which are now taxed as corporate profit and then again as individual income.	92%
2 ***Reduce corporation income tax rate (now 38%)*** as rapidly as budget needs permit until it equals the initial rate for individual incomes (now 20%).	73%
3 ***Provide for averaging business' taxable incomes*** over a period of about 6 years to allow for losses in bad years.	97%
4 ***Provide for averaging individuals' taxable incomes*** over a period of a few years so as to treat fairly those whose incomes fluctuate.	86%
5 ***Reduce upper bracket individual income tax rates*** to a maximum of 50% in the $100,000 bracket and 75% in the million and over bracket.	76%
6 ***Treat capital gains, now taxed at a lower rate,*** like other income but provide full allowances for losses.	64%
7 ***Remove the privilege of tax exemption*** from all future issues of state and local government bonds.	92%

Hit-and-Run Revision Disastrous

Most of the reforms needed to prevent the federal tax system from smothering enterprise would lower federal revenues, at least temporarily. Elimination of the double taxation of corporate dividends might lop off $800 million. Dropping the corporate income tax from 38 percent to 20 percent might cut away as much as $4 billion.

Because we can not avoid enormous federal expenses in the years immediately ahead, all badly needed reforms of the type to which this article is confined obviously can't be made at once. Also there are other tax reforms bearing on consumption which obviously should be weighted in an over-all program of tax revision.

But this is equally obvious: We should have a general design for tax revision which would line up all the necessary steps. Then we could get ahead with tax reductions as rapidly—and as sensibly—as revenue requirements and political courage would permit. Tax cutting may come piece-meal, but tax planning must not.

Through such a design we might discover that some decidedly beneficial improvements in the federal tax structure can be made at relatively slight cost. But today there's no way to be sure. No one in Washington with access to the information has even undertaken to make the necessary estimate.

Instead, federal tax revision continues to be a hit-and-run business—and a short-run political business. Take, for example, the proposal of a 20 percent tax reduction across the boards. There are virtues in such a proposal. But how they stack up beside many other extremely urgent needs for tax reform remains a mystery.

Congress must dispel such mysteries. Only in that way will it do the job of converting our present jerry-built tax structure into a moderately safe abode for the American system of private initiative, sparked by adequate incentives.

James H. McGraw, Jr.

President McGraw-Hill Publishing Company, Inc.

THIS IS THE 56TH OF A SERIES

OUR TEACHERS—

They Need The Help Of Business Now

THIS is an appeal to raise school teachers salaries—fast. Such appeals are commonly addressed, rather vaguely, to the conscience of the community. This one is not. It is addressed directly to the business community, and to its hard core of common sense.

As a whole, the school teachers of the nation are taking an economic beating. So, too, are their close associates and co-workers, the librarians. In purchasing power, public school teachers salaries, after taxes, average about 20 percent less than they did eight years ago. Beginning salaries of librarians, always low, have fallen behind an equal amount in purchasing power. College and university teachers are not much better off. The pressure is particularly heavy on those in the lower ranks. As a group, teachers and librarians are close to the bottom of the economic heap.

Unless this situation is remedied promptly, it is confidently to be expected that:

1. The more competent teachers will continue to desert our schools in droves, and our libraries will remain inadequately staffed. More than 350,000 teachers — many of them the very able ones—have left the public school teaching staff of about 900,000 in the last six years. More than 100,000 of the replacements are "substandard." They cannot meet the minimum educational requirements of their jobs which, by admission of the profession itself, are none too high.

2. Those who remain will be organized increasingly into economic pressure groups. Teachers strikes and the rapid growth of unionism among teachers at present clearly indicate what is in store.

Many business men are so deeply disturbed by the resort to the strike weapon by some teachers to enforce their salary demands that their sympathy for the general plight of our teachers tends to be dulled. Such an attitude is understandable. It avails nothing, however, in eliminating the crisis in education caused largely by teachers salary troubles.

The crisis in education is a crisis for the nation as a whole. The work of our schools, colleges and libraries is such that its deterioration means deterioration of the nation. However, the salary crisis in education is in special measure a crisis for the business community. That community has a special stake in having a well-educated and well-disposed constituency.

Education and Unionism

There may be room for disagreement as to whether teachers should organize themselves in trade unions, and follow trade union tactics. However, there is no conceivable room for disagreement as to whether organization of teachers into a fighting economic pressure group under the lash of a teachers salary crisis would be a body blow to business. Among many teachers it would foster an abiding hostility to the institution of business which, occupying a key position in the life of the community, had not done its utmost to make such unionization unnecessary by taking a lead in relieving the teachers salary crisis.

In our work of publishing technical periodicals and text books, we at McGraw-Hill meet and come to know many teachers and librarians. We know that, as a group, they have little appetite for participation in militant economic pressure groups. They are far more interested in making a militant assault on ignorance and prejudice through concentration on their professional work. If, through neglect of their economic needs by the business community, they feel forced to resort to trade union organization and tactics, the teachers and librarians can be expected to have an abiding re-

sentment toward the institution of business. That resentment will, in turn, be communicated in no small measure to the coming generation. Such is the nature of the educational process.

The crisis in education is not, of course, exclusively a matter of salaries. Unsatisfactory working conditions also play a part. Many schools are dilapidated and terribly overcrowded. So are some libraries. Some small-town school boards oppressively insist that the school teachers be the paragons of piety the board members wish they were themselves. Protection of a proper degree of academic freedom is sometimes missing. The teacher is rarely accorded a prestige comparable to the importance of the job. Elements such as these aggravate the crisis in education. But the first and absolutely essential step toward surmounting the crisis is to provide tolerable salaries.

Because of the enormous diversity of local conditions affecting teachers and librarians salaries, no general rule for emergency action would fit all cases. From state to state, average yearly expenditures on education in 1940 varied all the way from about $30 per pupil to about $150. Some states, like Nebraska, finance their schools almost exclusively from local taxes. Others, like Delaware, rely almost entirely on state taxes. Some states and communities have already acted to meet the salary crisis. Others have not. Variations such as these limit any generalization.

Guide for Emergency Action

But as a general proposition it can be safely said that the minimum requirements of the emergency will not have been met so long as the salaries of class room teachers and junior members of college faculties and library staffs have not been increased by the amount necessary to keep them abreast of the increase of about 50 percent in the cost of living since 1939. In many cases, a temporary cost of living adjustment might prove the best way to handle the problem.

This suggestion, let it be repeated, is not offered as a solution of the salary problem, but as a start. With their salaries increased enough to meet the increased cost of living, the teaching and library groups as a whole would still have cause to envy the current economic position of industrial workers. Since 1939, the average of weekly earnings of industrial workers after taxes, has outstripped the rise in the cost of living by about 21 percent.

However, a start and an absolutely essential start would be made toward giving America the sort of educational system it must have not only to fulfill its ideals but holds its own in this highly competitive world. We worry, and I think rightly, about having the free world engulfed by Russian Communism. According to the best figures available, the U.S.S.R. is spending about twice as large a share of its total national income for education as we are. The figures compared include our expenditures for both public and private education. That comparison is really something to worry about.

States Should Take Lead

In dealing with the salary crisis it is up to the teachers to display a maturity and integrity worthy of their profession. Teachers have many employment advantages, such as long vacations. They should not slur them over in making comparisons of their annual incomes. Also employment in teaching and libraries has been notably stable. Teachers and librarians should not ignore that fact in comparing their position with those whose employment has been far less steady.

At the same time, the great fiscal difficulties involved in solving the crisis in teachers and librarians salaries must not be used as an excuse for postponing effective action. The states are better equipped financially and otherwise to take such action than is the federal government and, with the localities directly involved, should take the lead. If the price of effective action is a heavier tax burden for communities already too heavily burdened that price must be paid. The crisis presents a major emergency. To handle it as anything less is to court irreparable damage to the nation as a whole, and a special measure of damage to business as well. The intelligent self-interest of business requires that it leave nothing undone to meet and master the crisis in education.

President McGraw-Hill Publishing Company, Inc.

WORLD LEADERSHIP...

Our Duty and Our Opportunity

CAPITALISM in Europe and the rest of the world is challenged by a real and formidable rival, communism. For capitalism to thrive a reasonable amount of prosperity is essential. Communism uses poverty to advance itself.

Except for the Western Hemisphere, most of the world came out of the war poor. Two years after V-E Day it is still poor. It needs dollars. It needs credit. It needs capital. It needs trade. It needs technical and managerial skills.

If we in America are to help the rest of the world back to its feet, starting it again on the road to peace and a free economy, we should try to supply those needs within the limits of our capacity.

We must not overtax our own strength. For the first requirement of a stable world is a strong United States. But we must accept leadership in international economic recovery—in our own self-interest.

What can the United States do to help men back to prosperity in a world economy which will allow them *freedom and incentive*? There are many things. But here are two of the most important:

1. The United States, through Congress, must determine the pattern and the total of the foreign loans or grants it can afford. We must answer three questions. How much will the new program cost? Can we afford it? Have we the technicians and managers to watch the loans, assuring their fruitful use?
2. We must demonstrate that we do not intend to raise our tariff walls to prohibitive heights when our debtors begin to repay us in goods and services, which is the only practical way they can pay us. Otherwise our loans will become losses.

If the United States is to meet even the minimum requirements of world rehabilitation, Congress eventually must authorize more advances than those to Greece and Turkey. The $400 million for those two countries will not do the over-all job of political and economic defense which we have begun. A minimum of $5 billion, if promptly and wisely applied in eight to ten countries, might suffice. BUT this $5 billion will be on top of approximately $16.8 billion which we have spent or earmarked during the past two years for use abroad, including our full share of the World Bank and Fund. We shall do a faster and more effective job if Congress will thus add up the foreseeable total of our international aid, and, even though the total looks imposingly large, commit us to it, with proper collateral safeguards from the debtor nations.

Congress need not try to foretell all contingencies, like last winter's weather in Britain, and it certainly should not create the impression that nations need only ask for billions to receive them. On the other hand, the war should have taught us the miserable consequences of "too little and too late." The President should have learned that he engenders skepticism by going to Congress with parts of a program, as he has done in the British, Grecian and Turkish loans. Within the limits of our capacity, we must make the decision now to see the whole job through—or throw in the sponge.

In the interest of the debtor nations—as well as in our own interest—the loan program should be hard-boiled. Rehabilitation loans must really rehabilitate. They must produce a state of economic health which will permit the World Bank and private capital to take over the task of financing world recovery—as perhaps can be done today in France and the Low Countries.

The loans, therefore, must be within the limits of our technical and managerial ability to implement them. Without technical help, Greece can not use its loan effectively—to rebuild railroads, clear ports, revive agriculture. Without skilled supervisors, Germany can not be made to pay its way. Money alone won't pull China from the brink of economic chaos.

Our lending calls for more than money. It calls for trained personnel to help the recipients utilize the loans effectively—geologists, construction and sanitary engineers, monetary experts, and management and agricultural specialists.

Loans are necessary but they are only a first step. A long-range program requires the opening of the half-closed doors of world trade—our own door, too.

We will have to get used to the idea that, when our debtors pay us, they must pay us largely in goods and services. Refusal to permit such repayments in the twenties helped start the world depression in the thirties—and the loss of our investments. *Imports do tend to raise living standards, and a two-way trade program need not require us to slash our present tariff rates.*

The complexion of our foreign trade has changed since the war. Our manufacturing capacity has increased and our raw-material self-sufficiency is tending to decline. For example, we probably shall have to continue importing copper and zinc and to increase our prewar dependence on imported lead. We may soon have to depend heavily on imported oil, and—gradually—on a growing volume of iron ore from abroad. Our normal dependence on imports for commodities like rubber, tin and silk will continue.

Our population has gone up 10 million in the last decade, and we now have a $176 billion national income, making room for more imports.

As a result of every nation's recent attempts to make itself secure and self-sufficient by slamming its trade door, a world-wide series of quotas and restrictions is blocking international trade. Even more, government buying and selling threaten to take commerce out of the hands of private traders, placing it in the uninspired care of bureaucratic negotiators.

Our government has taken the lead in calling the conference of 18 nations, now meeting at Geneva, to open as many trade doors as possible. The American delegates will bargain product by product and country by country—all summer, if necessary—for lower tariffs, fewer quotas and a free flow of private trade. The task is a long one, and the results are as yet uncertain, but, if success is achieved, an immense opportunity for good works and good earnings will lie before American businessmen.

This is no picayunish opportunity. Authoritative estimates put our 1947 exports at $11 billion and our imports at $6 billion. That's substantial. It is greater than the value of all crops grown on our farms ($10½ billion) and exceeds the value of all shipments of industries such as automobiles ($9 billion), textiles ($8 billion) and chemicals ($8 billion).

International trade is vital, not to be shrugged off, not to be kicked around as a football of party politics. Republicans and Democrats agree on a non-partisan foreign *political* policy. They should agree also on a non-partisan foreign *economic* policy. The foreign relations of the United States, political or economic, can no longer be log-rolled hither and yon.

A general program for international recovery, outlined here, will bring its full quota of aches and pains. But lack of a program will produce economic and political troubles on a vast scale; timid retreat will invite economic disaster and war.

By an intelligent, bold and resourceful program, we have a chance to win through to a long peace in the kind of world we want. *Unless America provides the leadership, there can be no such program.* Then Communism merely needs to hang around long enough to pick up the pieces.

Ours is the responsibility and the opportunity.

James H. McGraw, Jr.

President McGraw-Hill Publishing Company, Inc.

A NEW ENTERPRISE

Advocacy by the McGraw-Hill Publishing Company, in the accompanying editorial, of an effective world economic policy is not a mere verbal exercise. In the faith that we as a nation shall develop such a policy, this Company, following a trail blazed by leaders in American industry and finance, is expanding its operations overseas.

A newly created McGraw-Hill International Corporation will push forward the frontiers of our technical magazine and book publishing business throughout the world. The new Corporation comprises:

Eight international magazines—the McGRAW-HILL DIGEST, THE AMERICAN AUTOMOBILE and EL AUTOMOVIL AMERICANO, PHARMACY INTERNATIONAL and EL FARMACEUTICO, INGENIERIA INTERNACIONAL CONSTRUCCION, INGENIERIA INTERNACIONAL INDUSTRIA, THE MACHINIST.

A newsgathering agency, McGRAW-HILL WORLD NEWS, specializing in industrial and engineering coverage with correspondents in 36 world centers.

McGraw-Hill Publishing Company, Ltd. (London), serving the special needs of Britain and western Europe and publishing THE MACHINIST (London).

Five buyers' guides—AUTOMOTIVE EQUIPMENT (in English and Spanish), CONSTRUCTION EQUIPMENT, INDUSTRIAL MACHINERY and PHARMACEUTICALS (all in Spanish).

In addition, the McGraw-Hill Book Company has an overseas network for the distribution of its books.

YOUR CHANCES OF GETTING AHEAD

FOR 20 years we have been whittling away the foundations of our economic structure. We have been cutting away the incentives to "get ahead in the world," to increase production and to improve efficiency. Unless this process is reversed soon, we risk the sort of industrial stagnation that currently afflicts Great Britain so disastrously.

How far the whittling has gone is shown by the statement in the center of the page. It shows that everyone's stake in working harder and getting ahead has been reduced sharply since 1929. In that year, anyone who was even moderately successful could look forward to reaping the rewards of his success. If he earned $5,300 annually over a period of 25 years he could retire on a comfortable income of $3,000 per year. Or he could pile up enough capital to go into business for himself. He could fulfill the American dream as phrased by Abraham Lincoln in his first annual message to Congress in 1861:

"The prudent, penniless beginner in the world, labors for wages awhile, saves a surplus with which to buy tools or land for himself, then labors on his own account another while, and at length hires another new beginner to help him. This is the just and generous and prosperous system, which opens the way to all, gives hope to all, and consequent energy and progress, and improvement of condition to all."

Look at the situation today. To retire on an annual income from investment that will buy as much as $3,000 did in 1929, a young man needs to earn over $13,000 a year for 25 years. That's more than 2½ times the income he would have needed in 1929. The same thing is true of acquiring a stake in a business.

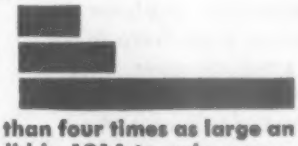
YOUR CHANCES OF GETTING AHEAD

To see how your chances of getting on in the world have changed during the past few decades, the McGraw-Hill Department of Economics has calculated how much it now takes to save enough to acquire a retirement income or a comparable stake in a business, as compared to what it took in 1914 and 1929.

The objective set is an income from investment equal to $3,000 a year in 1929 dollars. It is assumed that the savings required to yield this income are made over a period of twenty-five years. During that period it is also assumed that $4,000 per year (in 1929 dollars) is spent on living expenses.*

Here is how the figures work out:

	Yearly Income Needed
1914	$3,075
1929	5,267
1947	13,221



It now takes more than four times as large an annual income as it did in 1914 to gain a comparable stake. It takes well over twice as much as it did in 1929.

Changes in three factors — federal income taxes, living costs, and interest rates — explain why the income needed has multiplied so. Here's how these factors line up for the three years.

	Federal Income Taxes Married Man, 2 dependents		Cost of Living (Index Numbers 1935-39)	Interest Rate High-grade Corporate Bonds
	$5,000 Income	$10,000 Income		
1914	$10	$60	71.8	5%
1929	$3	$40	122.5	5%
1947	$589	$1,862	155.0	2½%

Similar calculations show that if we could reduce federal expenditures from $35 billion to $25 billion annually, raise interest rates by one-tenth and lower living costs by 15% — all realistic possibilities if we make the effort — then the income needed to build up such a retirement fund would come down to $9,500. The chances of realizing that goal would then be restored to what they were in 1929.

*Several other factors were omitted from the calculations because they would not have a decisive effect on the results. Thus, existence of social security pensions and retirement funds now reduces the income needed; but if state income taxes were added, the income needed would increase.

Why Try to Succeed?

While the income needed for retirement today has increased 2½ times — or by more than 150% — since 1929, the average person's income has increased only 80%. So the average man's chances of achieving success are really slimmer now than a generation ago.

This 1929-47 trend is something new in America. The average person's chances of getting ahead improved during 1914-29. In that period the dollar income needed for retirement or a stake in business rose by 75%, but the average income rose by 100%. So more people were within striking distance of success and security in 1929 than in 1914. The story has been different since 1929.

Fewer people actually do achieve financial success today. Only 1% of all families now have incomes large enough to build up a retirement fund or a stake in business. In 1929 almost 6% of all families attained a comparable degree of success.

Higher taxes are the most important reason why it takes so much more now to build up a competence. They account for one-half the increase in the amount needed. The other half is explained by higher living costs and lower interest rates.

It is, of course, true that few people ever get into the higher income brackets. So the process of cutting

away the incentives which play such a key role in our economic system affects comparatively few people immediately. It does, however, have a powerful indirect effect on all of us.

Everybody Loses

When half to four-fifths of any additional income of successful people goes to Uncle Sam a heavy drag is obviously put on doing the work to get it. Thus, we stand to lose the benefit of full use of the nation's best brains. By so doing we stifle industrial progress. And the loss in productive efficiency far outweighs the tax revenue the Treasury gains. Carried far enough, the process of stifling economic progress by slashing rewards leads straight to industrial stagnation.

The same process also multiplies the risks of embarking on new capital investment. High taxes rule out all but the most profitable new projects and restrict most expansions to boom times when profits are high. So capital investment follows a boom and bust pattern and, by so doing, contributes much to ups and downs in production and employment.

The Sorry Plight of Britain

The case of Britain today provides an object lesson of how blighted incentives produce industrial stagnation. *Britain's number one economic problem is to get more production. But the tax load there is so heavy it stifles the incentive to produce more.*

A coal miner who works an extra shift pays about a third of his added earnings to the tax collector. And, as the London *Economist* comments, tax rates on business executives are so high that they kill every incentive except that to tax evasion. In short, not only is the incentive to succeed blighted, but so is the incentive to work.

A root-cause of Britain's trouble is this: The cost of an expensive program of social benefits has been piled on top of the heavy costs of paying for past wars and trying to prevent future wars. Tax rates are boosted accordingly. What her experience proves is that the attempt to provide excessive social benefits may defeat itself. It raises the tax burden on rich and poor alike and smothers the incentive to work. So the underlying basis of all economic benefits—production—is eaten away.

We in the U. S. haven't traveled as far down the stagnation road as Britain has. Taxes amount to about 26% of national income here as against about 45% there. But, unless we start soon to build up incentives to do better work, instead of whittling them away as we have been doing, we will catch up with Britain fast.

It's Late but Not Too Late

Can anything be done? Decidedly yes, *particularly by tax reform and reduction in the cost of living.* As far as interest rates are concerned, any large increase would raise excessively the cost of carrying our war-swollen national debt, and hence raise taxes. But some increase in what are now excessively low interest rates may well be both feasible and desirable.

Action on the tax front is the first order of business. Our jerry-built tax structure is the thing that is chiefly responsible for cutting the incentives to work harder. Two things are important: 1) Government spending must be pared to the bone; 2) The tax system must be completely overhauled to remove the shackles on all-out production.

The 56th editorial in this series, published in March, outlined major steps that need to be taken in remodeling federal taxes in order to increase incentives to individual and business enterprise. *The revenue bill now before Congress is no more than a short step in the right direction. Much more must be done to clear the way for high production and rising living standards.*

Lifting the blight which taxes now place on incentives would help cut the high cost of living. It would stimulate greater production and greater efficiency. But a further step is necessary. Part of the benefits of improved efficiency must be passed on to consumers in the form of lower prices.

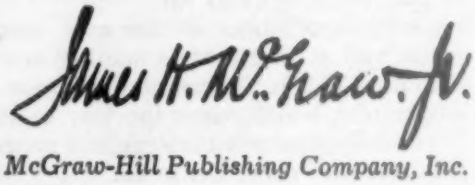
In the past few years we have been following precisely the opposite course. In many cases wages have been increased all out of proportion to increased productivity. Result—soaring prices and a severe squeeze of the consumer, to which some greedy exploitation of war-created shortages has also contributed.

To Give Ability a Chance

Our basic and most crucial problem is to get back on the track which leads to higher production and improved living standards all along the line. We got off that track in the 30's. Then, we started scrambling for larger slices of the same pie instead of trying to produce a larger pie. Now the process of getting back on the track is greatly complicated by the tremendous tax burden growing out of the war.

Yet it's not too late to turn back from the road that leads to industrial stagnation. As the statement in the center of the page shows, we could restore the odds of getting ahead to what they were in 1929. Cutting the federal budget to $25 billion a year and putting the tax structure in good order are the crucial first steps.

By taking these steps soon, Congress can go far to restore the incentives to hard work and efficiency which have been so largely washed away in the past 20 years. If they are not taken the American dream of getting ahead by hard and effective work will exist only in the history books, and our children will inherit from us an economic order without opportunity, without hope, without individual liberty.



President McGraw-Hill Publishing Company, Inc.

THIS IS THE 59TH OF A SERIES

THE RUHR— VALLEY OF DECISION

FOR AMERICANS and for American business the most important single spot on earth today is the Ruhr Valley of Germany—a valley no bigger in area than the State of Rhode Island. Upon recovery in the Ruhr hinges recovery in Europe. Upon recovery in Europe hinges the peace of the world.

No machine can run with its most important part missing. Western Europe without the Ruhr is a dead machine. Before the war, over half the coal and steel produced in the Western part of Continental Europe came from this one little valley. Today, the fact is that no other region in Europe has the technical skills and enterprise to produce the industrial supplies which Europe must have if it is to help itself back to a self-supporting economy. And, after observing Europe for many weeks, I am convinced that no one but the United States can successfully supervise the rebuilding of the Ruhr.

If you will keep four considerations in mind, as the international politicians gamble, you can easily tell whether the United States is playing its proper role in the rehabilitation of the Ruhr. Here are the four considerations:

I. We are paying for the Ruhr rehabilitation (or the lack of it).

II. We alone have the skill and enterprise to supervise its rebuilding.

III. It will be a tough organizing job requiring money, hard work, and outright sacrifice on the part of management men and technicians.

IV. We had better do it well if we love our children.

I

We are paying for rebuilding the Ruhr—or we soon shall be. The British now control the Ruhr, its government and its industry. They have been paying out about four hundred million dollars—American dollars—a year to buy the food, raw materials and equipment needed to rebuild the Ruhr. The British must spend American dollars for these supplies because the supplies can not be bought anywhere but in America. Thus far the British have, in effect, obtained the dollars which they spend for the Ruhr by drawing them out of the $3,750,000,000 loan which we granted Britain last year.

Now the loan is fast running out. The British lack dollars and other assets. We must take over, directly or indirectly, the dollar expenditures for rebuilding the Ruhr. We shall pay for it. Therefore—

II

We should supervise it. The British have been running the Ruhr's industry. They might conceivably suggest to Washington that they continue to run it while we pay the bill. *That we should never agree to.* There is a sound old rule that he who pays the piper shall call the tune.

Perhaps we would not need to invoke that rule if the British had done a good job reviving the industries of the Ruhr. *They have done a poor job—physically and ideologically.*

The physical output of the coal mines and steel mills of the Ruhr in recent months was actually smaller than at the first of the year. Production of coal amounts to little more than half of the pre-war 127 million tons per year. Steel productions limps along at one-sixth of the pre-war rate—far below the volume permitted even under the present low level-of-industry plan for Germany.

Ideologically, the British Labor Government has tried to export to Germany the brand of socialism which is making such a dubious record at home. Foreign Minister Bevin—although he may now have misgivings about it—committed himself to nationalization of the Ruhr's coal and steel industries. British representatives have pushed hard to get General Lucius Clay, our able military governor in Berlin, to agree to socialization of the Ruhr. So far, he has resisted this pressure, but our State and War Departments and we as individuals must back him up to the limit if he is to continue to combat this pressure successfully.

Even if the British government were not socialist, there would be good reason for questioning the ability of Britain to rehabilitate the industries of the Ruhr. In recent generations, the British management class has shown itself more

interested in cartels, restricting output, and allocating markets, than in full-steam, ingenious enterprising production.

Certainly the British must remain full partners in the *political* administration of Germany. No one suggests anything else. However, their recent production record demands turning the job of revitalizing the Ruhr industries over to the nation which is paying the bill and which leads the world in production.

If we have any faith in the business philosophy by which we have lived and prospered for 170 years, we should demonstrate that that philosophy still is dynamic by taking up the burden of the Ruhr.

III

It will be a tough job. It will require men and supplies and money from the United States. It can not possibly be done in less than five years. A list of some of the necessary steps shows how hard it will be.

A. Plans for socializing the Ruhr should be shelved quickly. The industries there should remain in trusteeship for five years. Then the Germans themselves should decide their ownership; let us hope that by that time we can demonstrate to them that private ownership and private initiative mean high production, good distribution and high wages.

B. The top supervising management jobs—both the top policy and the top technical jobs—required outstanding business ability. That is why American business men must be willing to go to Germany, sacrificing comfort and leisure, and even income, if necessary.

C. Germans should take over the management job at the operating level. The Germans are good technicians. They have a greater incentive than anyone else for getting the Ruhr back in working order. That incentive should be harnessed.

D. Special effort should earn special rewards. There is nothing wrong with the Ruhr (or the rest of Europe) that hard work will not cure. Before a man will work hard, he must feel that his work will advance him and his family. That simple motive, which powers our whole economy, must be revived in the Ruhr. To revive it requires enormous ingenuity and work . . . a new currency . . . a logical customs union . . . a sensible ration system . . . enough food, clothing, housing and consumer goods so that the worker can buy something with his currency and his ration points.

E. America will have to furnish a good share of these foodstuffs and supplies. Certain key items of equipment also will be needed. Only as we succeed in our job can this flow be diminished.

F. A sensible priorities system must channel Ruhr coal and steel into those uses which, in turn, will further increase output. Repair parts for railroad cars should stand high on the list. Housing, coal equipment and machine tool parts should come ahead of the automobiles and permanent steel bridges which at times have been accorded preference.

German technical management of industry in the Ruhr—point C above—need not mean *political* control of the Ruhr by some future sovereign German state. As the French know, the Ruhr, next to the atomic bomb, is the most dangerous weapon in the world. It is the arsenal without which no European power, even Russia, would dare start a war. There is no sense in turning that arsenal back to the *political* control of a nation which twice in 25 years used it for aggression. (And three times since 1870.) Surely we have enough resourcefulness to let the Germans who live in the Ruhr run the industries there without turning political control over to a central Prussian state.

This partial list shows how much hard work and statesmanship the United States must put into the Ruhr. But—

IV

We had better do it if we love our children. If we do not do this job—if we should pull out of Germany or fail there—we leave behind us a vacuum which neither Britain or France has the strength or ability to fill. Russia has the will and, if left unopposed, the power to fill that vacuum. Therefore, the day we fail or the day we pull out of Germany, the third world war takes a long step closer to us and certainly to our children. What greater incentive does any American need to work for than our success in this field?

If we succeed, the western zones of Germany in conjunction with Belgium and Holland can become self-supporting in three to five years. That way lies recovery for all Europe. That way lies peace for the world. That way lies vindication for the American business system in which we believe—the system of competitive private enterprise, with freedom for the individual and his initiative.

President McGraw-Hill Publishing Company, Inc.

THIS IS THE 60TH OF A SERIES

WHILE WE DELAY—

Russia Drives for the Atlantic

IN THE STRUGGLE to keep western Europe west of the Iron Curtain it is later than you think. Unless the United States quickly mobilizes its own and other nations' resources, World War II will be lost as World War I was lost—by no economic follow-through.

Millions of people in western Europe, living in cold homes or no homes at all, face another winter of near starvation. Some countries are absolutely without dollars to buy abroad the food and fuel they need for survival. Others slide toward that desperate state.

In this welter of misery Russia grasps for dominion over all Europe. Everywhere, as cold and hunger deepen and as men begin to doubt America's determination to help, Russia turns on the pressure. In France the Communists drive to overthrow the Government. In Italy they do likewise. In Greece Russia kills the United Nations investigating commission. In Trieste Tito elbows us out of the way. In Germany and Austria the Soviet commanders alternately stymie and flout the Allied governments.

FACED WITH this bloodless attack, the leaders of western Europe and of the United States have not covered themselves with glory.

Look, for example, at what the sixteen European countries participating in the Paris meetings on the Marshall "plan" first proposed to the United States as a catalog of their needs. In the main it was simply an adding up—to $30 billion—of what the various countries thought they needed to keep going in the same old way at the same old stands. There was no real start on plans for the mutual aid by European states which is the essence of a successful recovery program . . . no real start on plans to knock down the barriers which divide European trade into hopelessly inadequate little pockets . . . no real plans to clean up currencies which deteriorate so fast nobody wants to work for them. *In fact no plans to make people want to work.*

Meanwhile, what have our leaders offered? Not much more than one fine commencement speech by General Marshall, outlining a good idea, and a couple of carloads of statistics, with more to come.

Not even a beginning has been made on the most crucial part of any European aid program—*that of explaining to the American people what their part must be and why.* It is true that not all the reports of all the statistical committees have been completed. They never will be. But it is also true that the broad outlines of what the United States must do to save Europe are already clear. And it is not simply to provide more dollars, although $12 to $16 billion more—the cost of 6 or 8 weeks fighting in World War II—may be required.

A far more basic requirement is leadership which will lift Europe out of the slough of despair and get recovery rolling. Without that leadership more billions for Europe will buy us nothing but more bitterness and remorse on both sides of the Atlantic.

WHAT ARE the ingredients of that leadership? Here are a few:

1. A bi-partisan program for European recovery.

It should be so thoroughly understood and so overwhelmingly supported by both parties that playing politics with it will be like selling military secrets to the enemy.

Truman and Vandenberg have failed miserably to develop and explain a complete program—one in which Europe and America can have full confidence. Nor have Taft and Dewey and other candidates for high office pledged that politics will stop at our shoreline. These men must speak out. To date Herbert Hoover alone has had the courage and vision to state a program.

2. A mobilization of American food supplies.

We must assure people at home and abroad that our crops, cut down by drought and heat, will be stretched to cover minimum European needs (with whatever help we can muster from other nations) without forcing still higher food prices here.

Some food experts are comfortably confident that the stretching can be done. But

meatless and wheatless days, higher extraction of flour from wheat and similar voluntary conservation moves would make it surer. And they would demonstrate that a free country can mobilize itself to meet a very serious crisis.

3. An understanding that relief is one problem and recovery another.

Both problems must be solved. Relief emergencies must be met, some of them at once. But they must not black out the longer task of recovery. Italy illustrates the point. Italy, particularly the south, is flat broke. Help is needed right now to keep people from dying in the streets. But we must eventually do more than keep the Italian people alive. We must help them get back to useful work so that they can stand on their own feet.

4. A steady insistence on results—which means that Europe must find a way to make its people want to work.

In the U.S.S.R. they have a way to get things done. It is to liquidate those who do not work. In the U.S.A. we have a way to get things done. It is to create incentives to make people want to work. Western Europe, notably France and Britain, has fallen between two stools. It has socialized away the incentives, and it does not yet, thank heaven, enslave the laggards. We should make it crystal clear that we have no designs on the national "sovereignty" of others. But we should make it equally clear that we insist that those countries which receive our aid work hard enough to get results. To this end continued aid should be on an installment plan, each installment conditional on getting results. Otherwise more billions can easily disappear down the drain.

5. Insistence on all-out self-aid by European countries.

That is the constructive core of the Marshall idea—to help Europe to help itself. In his brilliant "Report on Germany" and how to get it "off the backs of the American taxpayer," Lewis H. Brown, Johns-Manville Chairman, shows how the export of only 10 million tons of coal a year from Britain to western Europe would speed industrial recovery of the Ruhr immeasurably. There are countless other cases where effort in one European country—or a group of countries—will break a big industrial bottleneck in another. We should insist that everything possible be done to see they are broken.

6. An agreement with Britain and France giving us authority in western Germany equal to our responsibility.

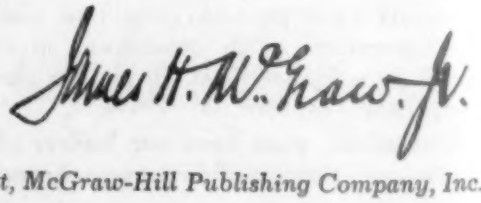
Britain is shifting to us most of the financial burden she has been carrying in the German occupation. Less directly we shall also be carrying much of the French occupation load too. We must have authority in the economic field commensurate with our responsibilities. Otherwise the management of western Germany can poison Anglo-American and Anglo-French relations in addition to wasting resources we could use to promote general European recovery.

It is truly said in the scriptures that the Lord loveth a cheerful giver. But it is not recorded anywhere that anyone, including the recipient, loves a soft-headed giver. Hence as a capstone any program of aid for Europe should have machinery assuring that only what is needed is sent; that what is sent does the job for which it is sent; and that arrangements are made for the recipients to pay back whatever they can.

THE AMERICAN PEOPLE should be told clearly by their leaders that there is no assurance that the best possible program of economic aid for Europe will do the job. The time is very late.

In France and Italy, as our help falters, the Communists right now are provoking strikes which will make the people's suffering more acute. They hope, of course, to overthrow the governments in both those countries and to seize control. If Communist dictatorships are clamped on France and Italy this fall, Russia and her satellites will have advanced to the Atlantic. The Iron Curtain will have moved 500 miles west—toward us.

Americans should be clearly told, therefore, that not to undertake an immediate program for the recovery of Europe is to bring closer the greatest possible national disaster—World War III.



President, McGraw-Hill Publishing Company, Inc.

THIS IS THE 61st OF A SERIES

TAFT-HARTLEY ACT

Frees "Slave" Labor

THE TAFT-HARTLEY ACT is two months old. Its full meaning is yet to be determined by decisions of the National Labor Relations Board and the courts. However, on its face, the Act refutes the attacks made upon it by union leaders as hysterical and fanciful.

Management has had every provocation to reply to these attacks in kind. To the credit of the employers of this country, they have not succumbed to that temptation. They have maintained a temperate attitude toward the new law and the problems it is designed to correct. This approach is right. But it is only an approach.

Union leaders will want to settle for nothing short of *repeal*. Their attack on the Act has made some headway. It may be more effective as time goes on. *Certainly the Taft-Hartley law will be repealed if management just sits tight and lets union leaders continue to confuse their followers.*

Management, therefore, must implement its present temperate attitude with a program of positive action. The Taft-Hartley Act must be made to work not because management wants it, but because it is fair to labor—and management can do things right now to see that the Act works. Management can:

I. Utilize every means at its disposal to acquaint the rank and file of union workers with the truth about the Taft-Hartley Act.

II. Suggest amendments to the Act if experience indicates that amendments are necessary.

III. Use the law as little as possible in settling labor disputes.

IV. Stand firm in its refusal to bargain away the rights accorded by the Act to workers, management, and the public.

An examination of those four *must's* will show why they provide management with its best program of action.

I.

Union members do not know what the Taft-Hartley Act provides.

There is abundant proof of that statement.

While Congress was still trying to write a law that the President would not veto, FACTORY magazine asked workers how they felt about major proposals in the pending House and Senate bills. Overwhelmingly they felt good. They were in favor of almost every individual provision that was finally incorporated into the bill and passed over the President's veto.

The same story emerged from the national opinion poll made by the Opinion Research Corporation of Princeton, N. J. and published by Look magazine after the law was enacted. It showed that union members uniformly favored major provisions of the Act, but were strongly opposed to the Act itself.

This inconsistency is easily explained. Instead of telling their members what the Act does for them, most union leaders have been condemning it as "a slave labor law" because it curtails the leaders' power and recognizes the rights of the union member and the public.

It is not a slave labor law. All of the basic rights accorded to labor by the Wagner Act of 1935 are preserved by the Taft-Hartley law. All of the unfair labor practices that were forbidden by the Wagner Act are still forbidden by the Taft-Hartley Act.

Nothing in the law impairs labor's right to bargain through representatives of its own choosing.

The Wagner Act condemned as an unfair labor practice any effort by employers to coerce employees in the selection of their bargaining representatives. So does the new law.

The Taft-Hartley Act merely recognizes rights of individual employees, of management, and of the public that were ignored by the Wagner Act.

For example, while the Taft-Hartley Act continues the workers' protection from coercion by employers, it also gives them new protection against coercion by unions. The individual worker is freed from the necessity of joining a union to *get* a job. He may still be required to join a union to *keep* his job, but not unless a majority of the workers vote for such a requirement in a government-supervised election.

Some people think the Taft-Hartley Act is weak in protecting the rights of the individual worker. They think that membership in a union should never be made a condition for holding a job. This is true. However, the Act does restore to the individual worker some rights which were blotted out under the Wagner Act, just as it does to management and the public.

A fair examination of the new law's provisions will show that they spring from one dominating purpose: i.e., to re-establish equality before the law.

For example, under the Wagner Act union leaders were free to say whatever they pleased about the employer to his employees. The employer, on the other hand, was denied freedom of speech in talking to his own employees. Now freedom of speech is largely restored.

Under the Wagner Act the employer was compelled to bargain with a certified union. Now the union must bargain, too.

Under the Wagner Act, unions alone had the right to petition for an election to determine whether the petitioning union represented a majority of the workers. Now the employer also has the right to secure an election.

These are features of the new Labor law that management must help workers understand. They must understand why the Act is not the "diabolical monstrosity" Philip Murray tells them it is.

Some companies have already started to explain these things to their workers. Techniques are well established, and they are techniques that any company can use. They include labor law digests in language workers can understand, supervisory conferences to cover points in the Act that affects the supervisor's handling of his job, distribution of reprinted articles that point out how employees benefit from the new law, editorials in plant newspapers and magazines, and advertisements in local newspapers.

II.

Management should take the lead whenever amendments to the Taft-Hartley law become necessary.

For twelve years labor leaders wilfully opposed every attempt to correct obvious abuses in the Wagner Act. We have now proved that a labor law *can* be amended. Let us be sure that management does not resort to the same obstructionist tactics labor has always used.

In carrying out its basic purpose to re-establish equality before the law, the Taft-Hartley Act makes it "unlawful... for any corporation whatever or any labor organization to make a contribution or expenditure in connection with" national elections. Corporations have long been so restrained. The novelty is the balancing restraint upon unions, which now have huge financial resources amounting to very many millions of dollars. However, the language of the Act *may* restrain the labor press from saying what it thinks about candidates, thus impinging upon the freedom of the press. Senator Taft has recognized this possibility.

If it should develop that the Act inadvertently throttles freedom of the press—or misfires otherwise—management should take the lead in securing suitable amendments to the Act. By assuming a completely stiff-necked attitude toward any and all changes in the Wagner Act, no matter how badly needed, the dominant labor leaders and their political outriders finally brought on the sweeping revisions provided by the Taft-Hartley Act. Management must not follow that example of stupid leadership.

III.

Management will be wise if it uses the new law gently in settling labor disputes.

So far employers show no disposition to use the law excessively. That is good. An analysis of the NLRB's docket from August 22 to September 30 shows that approximately 90 percent of the cases now before the Board were filed by unions and employees — not by employers.

We have been surveying employers, asking if they will have occasion to use their right to sue their unions. The answer so far is consistently, "*no.*" That answer frequently is accompanied by this remark, "We certainly hope not. We have no desire to conduct our labor relations in the courthouse."

The desired result should be for the Act to produce only those law suits that are matters of vital principle. As many employers have remarked, the courthouse remains the worst possible place to conduct labor relations. The best place is in the plant—by free collective bargaining between parties enjoying an equality before the law. The Taft-Hartley law will serve its most constructive role if it encourages this kind of collective bargaining.

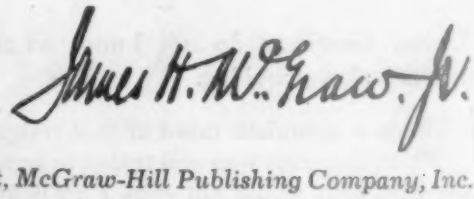
IV.

Employers should not bargain away legal rights accorded to them by the Taft-Hartley Act.

By bargaining away rights given them in that Act, employers serve only to upset a carefully created balance of equality before the law which is an essential element of fair collective bargaining.

Also, by bargaining away rights properly accorded to them, they let down those members of Congress who, in voting for the Act, braved continuous threats of political assassination by powerful union leaders. For their statesmanship in the complicated field covered by the Taft-Hartley Act these Congressmen deserve the support and gratitude of the whole nation—of management, of labor, and of the public alike.

Fairly handled on all sides, the corrective force of the Act can be made a major bulwark of industrial freedom.



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